File Ref.No.Ac.A3/Faculty of Technology/2023

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

(Abstract)

Faculty of Technology - Department of Computer Applications- Resolution of the Academic Council - Communicated - Orders issued.

ACADEMIC A SECTION

No.CUSAT/AC(A).A3/801/2025 Dated,KOCHI-22,28.02.2025

Read:-Item No. I (b) (I) of the Minutes of the Meeting of the Academic Council held on 21.01.2025

ORDER

The Academic Council, vide item read above, considered along with the recommendations of its Standing Committee, the Minutes of the meeting of the Faculty of Technology held on 08.01.2025 and resolved to approve the following :

1. Regulation, Syllabus (I to IV semesters) and Course Structure of the Five-year Integrated MCA programme with effect from 2025 admission onwards. (**Appendix I)**

2. Regulation, Syllabus and Course Structure of the Executive M.Tech in Computer Science and Engineering to be offered for working professionals with effect from 2025 admission onwards **(Appendix II)**

3. Inclusion of B.Voc (Data Science) as eligibility for admission to MCA, M.Sc Computer Science with Specialization in Artificial Intelligence and M.Sc Computer Science with Specialization in Data Science programmes of the Department

4. Change in Eligibility Criteria of the existing two-year MCA programme as follows:

   i. Passed BCA / B.Tech / BE

   OR

   Passed B.Sc / B.Com / BA / B.Voc (Business Process and Data Analytics / Data Science) with Mathematics at the 10+2 level or as a part of their graduation curriculum.

   ii. Should have obtained atleast 50% marks in the qualifying examinations from a recognized University / Institute

   iii. Candidates lacking foundational knowledge in relevant subjects will be required to complete additional bridge courses as per University norms".

5. Change in Eligibility Criteria of the existing M.Sc Computer Science with Specialization in Artificial Intelligence programme as follows:

   "Any Science graduate with Mathematics as one of the core or complimentary subject or graduate in Electronics / Information Technology / Computer Science / Computer Applications / Engineering / Technology / B.Voc Data Science with aggregate 50% marks or equivalent CGPA from a recognized University / Institute".

6. Change in Eligibility Criteria of the existing M.Sc Computer Science with specialization in Data Science programme as follows:

   "Any Science graduate with Mathematics as one of the core or complimentary subject or graduate in Electronics / Information Technology / Computer Science / Computer Applications / Engineering / Technology / B.Voc (Business Process and Data Analytics / Data Science) with aggregate 50% marks or equivalent CGPA from a recognized University / Institute".

7. Change in Eligibility Criteria of M.Voc (Software Application Development) programme as follows:

   "Engineering graduates with 50% marks (or equivalent CGPA) in the branches of Information Technology / Computer Science / Electronics and Communication OR Graduates with 50% marks (or equivalent CGPA) in Computer Science / Computer Applications / Information Technology / Electronics / Software Development or Graduates with B.Voc Degree in relevant disciplines with 50% marks (or equivalent CGPA)".

8. Unification of Test Code for CAT for M.Voc (Software Application Development) programme with that of MCA programme. The common Test Code is 501.

9. Regulations and Curriculum for the MCA programme offered by the College of Engineering, Thalassery, a recognized Institution of Cochin University of Science and Technology with effect from the Academic Year 2024-2025 (**Appendix III**).

Orders are, therefore, issued communicating the resolution of the Academic Council.

Dr. Arun A U *

Registrar

To:

1. The Dean, Faculty of Technology
2. The Chairperson, BoS in Computer Applications
3. The Head, Department of Computer Applications
4. The Principal, College of Engineering, Thalassery
5. All AR/DR Examination wing - with a request to forward to sections concerned
6. The Director, IQAC/ DoA / PDO
7. CIRM/Conference Sections
8. PS To VC/PS to PVC/ PA To Registrar/PA to CE
9. Stock File/File Copy

* This is a computer generated document. Hence no signature is required.

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

REGULATION, CURRICULUM & SYLLABUS

FIVE-YEAR INTEGRATED MCA

for

DEPARTMENT OF COMPUTER APPLICATIONS

Department of Computer Applications
Cochin University of Science and Technology

VISION

To become a centre of excellence in Computer Applications and impart innovation-oriented education for building globally competent and socially committed professionals.

MISSION

M1: To develop technically competent professionals and equip them for research, innovations, higher studies and entrepreneurship.

M2: To mould software professionals with ethical values for developing technologies emphasizing on societal and industrial needs.

M3: To provide a globally recognized academic environment through industry – academia collaborations, digital learning and state of the art skill development.

M4: To foster students by enriching universal human values to work in multidisciplinary domains exhibiting leadership qualities and teamwork.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

PEO1. Apply principles of mathematics and computing to design, develop and test softwares for quality, security and utility.

PEO2. Work in a multidisciplinary team to understand software requirements and engage in applying technologies for solving complex computing problems.

PEO3. Engage in lifelong learning to keep pace with the changing landscape of technologies for professional advancement.

PEO4. Communicate effectively and demonstrate professional ethics with societal responsibilities.

PROGRAMME ARTICULATION MATRIX

	M1	M2	M3	M4
PEO1	**X**	**X**		
PEO2	**X**	**X**		**X**
PEO3				**X**
PEO4		**X**	**X**	

PROGRAMME OUTCOMES (PO's)

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

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

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

4. **Conduct Investigations of Complex Computing Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

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

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

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

9. **Communication Efficacy:** Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations and give and understand clear instructions.
10. **Societal and Environmental Concern:**Understand and assess societal, environmental, health, safety, legal and cultural issues within local and global context, and the consequential responsibilities to professional computing practice.

11. **Individual and Teamwork**: Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary environments.

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

PROGRAMME SPECIFIC OUTCOME (PSO's)

PSO-1: Apply the knowledge of mathematics, statistics, and computer science to deliver solutions for emerging problems in the data science domain using specialist software tools for data storage, analysis and visualisation.

PSO-2: Apply research and investigation to solve sustainable problems related to the environment, industry and society with ethics, and manage projects related to other interdisciplinary fields.

REGULATION

REGULATION FOR FIVE-YEAR INTEGRATED MCA PROGRAMME UNDER CHOICE BASED CREDIT SYSTEM (CBCS) OFFERED BY THE UNIVERSITY DEPARTMENT/SCHOOLS
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

The regulations are designed to serve as a comprehensive resource for the preparation of curriculum for the Five-Year Integrated Post- Graduate programme (FYIPGP), five-year Integrated MCA. The regulations aim to provide a structured and comprehensive educational experience for students pursuing a specific academic degree. The document aims to facilitate a transformative process that ensures the programme will be student-centred, and aligned with the evolving needs of higher education and employment.

1 SCOPE

1.1 These Regulations shall apply to the five-year Integrated MCA programme conducted by the Department of Computer Applications/Schools, Cochin University of Science and Technology .

1.2 The provisions herein supersede all other Regulations with respect to such PG programmes unless otherwise provided.

2 DEFINITIONS

2.1 **Department/School** means Department/School instituted in the University as per Cochin University of Science and Technology Statutes and Act.

2.2 **Academic Committee** means the committee constituted by the Vice-Chancellor under this regulation to monitor the conduct of the programmes.

2.3 **Credit** is the quantity of instruction given or the learning outcomes and a notional time to achieve those outcomes.

2.4 **Core Course(CC)** means a course that the student admitted to a particular programme must successfully complete in order to receive the Degree and which cannot be substituted by any other course.

2.5 **Discipline Specific Elective (DSE)** is a course of a particular discipline that a student has the choice to select from a pool of such courses from his/her programme of study. The DSEs to offer in a programme of study would be identified by the concerned Department/School.

2.6 **Audited Course(AC)** means a course which can be opted by a student but which will not accrue any credit.

2.7 **Ability Enhancement Courses (AEC)** are the courses designed specifically to achieve competency in modern Indian/world languages and English with special emphasis on communication skills**.**

2.8 **Skill Enhancement Courses (SEC)** are designed to develop Creativity, Critical Thinking, Communication, and Collaboration, which are known as 21st-century skills.

2.9 **Value Added Courses (VAC)** are the courses meant for personality development, perspective building and developing self-awareness of a graduate student.

2.10 **Multi-Disciplinary Elective (MDE) courses** are the courses intended to broaden the intellectual experience and to build a conceptual foundation about arts, science, commerce, language, and social sciences among students.

2.11 **MOOC Course** means a Massively Open Online Course offered by UGC, CUSAT or any other recognized educational agencies approved by the University.

3 STRUCTURE OF PROGRAMME

Five-year Integrated PG Degree: A five-year PG Degree in a Major discipline will be awarded to those who complete a five-year post graduate degree programme securing 215 credits and have satisfied the minimum course requirements as given. Students will be awarded following degrees based on the completion of credits as follows:

1. A **three-year UG Degree** is awarded upon securing 134 credits for three years of study.
2. A **four-year UG Degree with Honours** is awarded to those completing178 credits for four years of study.

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**Total**
CC & DSE(Major)	5	15	15	9	19	5	14	8	4		**94**
AEC	4	2		2		4					**12**
MDE	2					7					**9**
VAC	3	3	3								**9**
SEC	3	3		3					2	20	**31**
CC & DSE (Minor)	3	3	6	8		4	5	5	11		**45**
Research/ Internship					3		4	8			**15**
Sem Total	**20**	**26**	**24**	**22**	**22**	**20**	**23**	**21**	**17**	**20**	
Total Credits											**215**

Abbreviation	**Definition**
CC	Core Courses
AEC	Ability Enhancement Courses
MDE	Multi-Disciplinary Elective Course
VAC	Value Added Courses
SEC	Skill Enhancement Courses
DSE	Discipline Specific Elective

4 CURRICULUM STRUCTURE

As per the AICTE, FYIPGP regulation of Cochin University of Science and Technology and Government of Kerala Five year Integrated PG Programme

5 CREDIT DETAILS

5.1 A course that includes one hour of lecture or tutorial or a minimum of two hours of lab work, practical work, or field work per week is given one credit.

5.2 One credit in a semester should be designed for 15 hours of Lectures or Tutorials or 30 hours of practicum and learner engagement in terms of course- related activities such as seminar preparation, submitting assignments, etc.

5.3 A one-credit seminar or internship or studio activities or field work/ projects or community engagement and service will have two-hour engagements per week (30 hours of engagement per semester).

5.4 Maximum Number of credits that a student can earn per semester shall be restricted to 30.

6 DURATION OF PROGRAMMES, CREDITS REQUIREMENTS AND OPTIONS

6.1 The University shall admit candidates not only for programmes, but also for courses, however, the admission is subject to the availability of seats in the respective departments.

6.2 The students will be allowed to pursue BCA programme within a period of 5 years, BCA Honours/BCA Honours with research within a period of 6 years, and MCA within a period of 7 years without obtaining readmission.

6.3 The lateral entry for programmes in the odd semesters are allowed based on the admission rules of the University from time to time, and subject to the availability of seats in the concerned Department/School.

6.4 The following exit options will be made available to the students joining five-year Integrated MCA Programme:

A. Three years: **Bachelor in Computer Application (BCA)**

B. Four years: **Bachelor in Computer Application with Honours: BCA (Honours)** or **Bachelor in Computer Application Honours with Research: BCA (Honours with Research)**

C. Five years: **Master of Computer Application (MCA)**

7 ELIGIBILITY FOR ADMISSION

The minimum eligibility criteria for the Five-year Integrated MCA program require candidates to have a minimum of 50% marks in Plus Two, with Mathematics, Computer Science, Informatics Practices, or Information Technology as one of the optional subjects from a recognized board.

8 ADMISSIONS

As per the Regulations prescribed by the University from time to time.

After admission, each student shall be assigned a Unique Registration Number in a format specified by the university. This number, issued by the concerned department, will remain valid throughout the student's program of study at the university.

9 COURSE REGISTRATION

9.1 Every Department/School shall have Faculty Members as Student Advisors. Each student will be assigned to an Advisor/Mentor, within one week from the commencement of the programme , by the Department council. He/She will advise the student about the academic programme and counsel the student on the choice of courses depending on the student's academic background and objective. The student will then register for the courses he plans to take for the semester before the classes begin and within the time prescribed by the University. The student should have completed the prescribed prerequisites if any for a course before registration. The student has to be closely monitored and motivated. The Advisor/Mentor must keep all records of the candidate – attendance, internal marks, end semester marks etc. Advisor/Mentor must keep frequent contact with the students and the periodicity must be recorded and placed before the department council.

The Department offering any course shall prescribe the maximum number of

students that can be admitted taking into consideration the facilities available.
Core courses of any programmes are to be compulsorily offered by the respective Department that offers the programme. In any Department preference shall be given to those students for whom the course is a core-course if the demand for registration is beyond the maximum prescribed.The student can drop any elective/audit course(s) within ***15*** working days after the commencement of the classes.

9.2 University shall make available to all students a Bulletin listing all the courses offered in every semester specifying the credits, prerequisites, list of topics, the course intends to cover, the instructor who is giving the courses, the time and place of the classes for the courses.

10 COURSE STRUCTURE

The detailed course structure is given in **Appendix I**, including course codes, Course type, level of course , semester distribution, and credit requirements.

10.1 The Department Council shall make recommendations on the content of core and elective courses including the detailed syllabus pertaining to each programme offered by the Department to the University to be approved by the concerned Board of Studies, Faculty and Academic Council. The Department Council shall have the freedom to design and introduce new electives and or audited courses, to modify/redesign existing electives and to replace any existing electives with new or modified/redesigned electives to facilitate better exposure and training for the students. Prior approval from the Board of Studies and Academic Council is not required for such modifications in the electives, but shall be done only with the approval of the Academic Committee. Such changes shall be placed in the Board of Studies, Faculty and Academic Council in the next meeting for ratification.

10.2 The attendance criteria of the programme shall be as given below:

A minimum 75 % attendance is compulsory. But the Vice-Chancellor shall have the power to condone shortage of attendance up to 10 % on medical grounds on the recommendations of the Head of the Department. However such condonation for shortage of attendance shall be given three times during the entire programme of study. Each semester shall have a minimum of 16 weeks duration.

11.EVALUATION

11.1 The entire system of evaluation is internal. The evaluation scheme for each semester contains two parts, a continuous assessment and a semester end examination. The continuous assessment shall consist of a minimum of two tests of twenty marks each and assignments/seminars/quizzes etc. of ten marks which shall be notified to the students at the beginning of the semester. Marks obtained in the continuous assessment shall be displayed on the notice board and grievances if any may be addressed to the Head of the Department. The Department Council shall finalise the marks of the continuous assessment of each course after addressing such grievances.

The semester end examination which will be of 3 hours duration shall cover the entire syllabus of the course. Equal weightage shall be given for the continuous assessment and the semester end components.

All practical examinations will also be internally evaluated as per the procedures laid down by the Department Councils concerned.

11.2 The question paper for the semester end examination shall be set by the concerned teacher in advance, which shall be scrutinized by the respective department council or by a committee consisting of the HOD and faculty members offering courses in that semester to ensure that questions are within the scope of the syllabus and that the entire syllabus of the course is fairly covered in the question paper. Modifications can be suggested by the council if necessary and such suggestions shall be incorporated in the final version of the question paper.

There shall be only a single evaluation for the semester end examination. Immediately after the examination is over, the Head of the Department shall make arrangements to complete the evaluation and finalize the results within 10 working days. The marks and grades in all the courses obtained by the students have to be displayed in the notice board and the answer scripts can be shown to the students for scrutiny if requested.

11.3 For each course there shall be a separate minimum of 45% marks for the semester end examinations.

11.4 The Department shall publish the marks obtained by the students, in the continuous assessment and semester end examination. If the student has any grievance, he/she can approach the concerned teacher and submit his/her grievance with supporting documents/arguments. The teacher and the Head of the

Department will examine the case and decide on his/her grievance. If the student is not convinced with the decision, he/she can approach the appellate authority, which is the department council, in writing and the council shall examine the same and take a final decision which has to be intimated to the student in writing. The decision of the appellate authority shall be final.

11.5 The final marks and grades obtained by the students shall be published in the notice board. Those who could not obtain 50% marks (Grade D) in total for a course will be declared as failed in that course. Those who fail in any core or elective course shall approach the concerned teacher if necessary for a reexamination of the semester end examination. Within ten days of the display of the results in the notice board, the department shall conduct an additional semester end examination for these candidates. This re examination is only to provide the student a chance to pass the examination by completing the course successfully. If he/she completes the course successfully making use of this additional chance, he/she will be awarded only a D grade enabling the candidate to be declared successful in that course**.** If he/she cannot make it up, he/she may repeat the semester end examination of that course in the next available chance. In this case also, he/she will be awarded only a D grade. If the student re-registers and repeats the course, he/she may be awarded whatever grade he/she has secured. The maximum duration for completing 3-year, 4-year, and 5-year degree programmes will be 5, 6, and 7 years, respectively, from the date of commencement of the first semester.

11.6 The result of the examinations will be finalised by the department council, which will act as the passing board and the minutes shall be sent to the controller of examinations for publishing the results and to issue the grade card.

Dissertation/Project Evaluation Criteria

The dissertation will be evaluated at the end of the VI, VIII, and X semesters by an examination committee consisting of the Head of the Department (HOD), a senior faculty member nominated by the HOD or an external expert from another university or industry nominated by the HOD, and the project guide.

At the end of each of these semesters, students must submit their dissertation on the project work to the committee by the prescribed deadline. The dissertation will then be evaluated through an open presentation, followed by a viva-voce examination.

For assessment purposes, the evaluation is divided into the following subcomponents:

Assessment by the project guide (based on periodic evaluation of the student's work) – 50%

Assessment by the examination committee – 50%

12 GRADE CARD

12.1 The University under its seal shall issue a Grade Card to the students on completion of each semester. The Grade card shall contain the following:

a. Title of the course taken as core, elective and audit. (An audit course shall be listed only if the student has secured a pass)
b. The credits associated with and the grades awarded for each course.
c. The number of credits (core and elective separately) earned by the student and the Grade point Average.
d. The total credits (core and elective) earned till that semester.

12.2 The following grading system be adopted for all the programmes .
The following grades will be awarded based on the overall performance in each subject.

Range of marks	Grades	Weightage
90 and above	S-Outstanding	10
80 to 89	A-Excellent	9
70 to 79	B-Very good	8
60 to 69	C-Good	7
50 to 59	D-Satisfactory	6
Below 50%	F-Failed	0

Overall performance at the end of the semester will be indicated by Grade Point Average (GPA) calculated as follows.

$$GPA = \frac{G1C1+G2C2+G3C3+\ldots\ldots..GnCn}{C1+C2+C3+\ldots\ldots\ldots\ldots\ldots\ldots Cn}$$

Where 'G' refers to the grade weightage and 'C' refers to the credit value of the corresponding course undergone by the student. At the end of the final semester Cumulative Grade Point Average (CGPA) will be calculated based on the above formula, considering the Credits and Grades earned during the entire programme of study.

Classification for the Degree/Diploma will be given as follows based on the CGPA :

First Class with distinction	8 and above
First Class	6.5 and above
Second Class	6 and above

12.3 The Grade Card issued at the end of the final semester shall contain the details of all the courses taken which shall include the titles of the courses, the credits associated with each course, the CGPA and the class.

13 MONITORING AND MANAGEMENT OF PROGRAMME

13.1 Every programme conducted in the Departments shall be Monitored by the Department Council subject to these regulations. Such monitoring shall include design of programmes , prescribing the mode of conduct of the programmes and monitoring the evaluation process of students.

14 ACADEMIC COMMITTEE

14.1 There shall be an Academic Committee constituted by the Vice-Chancellor to monitor and co-ordinate the working of the CBCS

System.

14.2 The Committee shall consist of:

a	The Pro-Vice-Chancellor	Chairman
b	The Registrar	Secretary
c	The Controller of Examinations	
d	One Teacher from each Department	

14.3 A Senior Professor nominated by the Vice-Chancellor from among the members of the Committee shall be the Vice-Chairman of the Committee

14.4 The term of the office of the committee shall be two years, but the committee once constituted shall continue in office until a reconstituted committee assumes office.

15 TRANSITORY PROVISION

Despite any provisions within these regulations, the Vice-Chancellor is granted the authority to issue orders for one year from the effective date of these regulations, allowing for their application to any program with necessary modifications as deemed appropriate.

16 REPEAL

The current regulations, to the extent that they apply to programs offered in University Departments and are inconsistent with existing regulations, shall be superseded by those relating to the CBCS System when applied to any program within a University Department. In cases of inconsistency, the regulations specific to the CBCS System will take precedence.

Appendix I

Note: The course code structure is organized as follows: the first 2 digits represent the syllabus year, followed by 3 digits indicating the course code. Next, 2 digits specify the semester, then 1 digit denotes the track (ranging from 1 to 5), and the final digit represents the course number within that semester.

SEMESTER 1									
	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0101	CC101(Minor) 300	Discrete Mathematics	3	0	0	50	50	3
	25-814-0102	SEC101 300	Problem Solving Techniques	3	0	2	50	50	3
	25-814-0103	CC102(Major) 400	Logic System Design	3	0	4	50	50	5
	25-814-0104	AEC 101	General English - I	2	1	0	50	50	3
	25-814-0105	MDE101	Indian Knowledge Systems	2	0	0	50	50	2
	25-814-0106	VAC 101	Environmental Science and Sustainability	2	1	0	50	50	3
	25-814-0107	AEC 102	Additional Course - Indian or Foreign Language Other than Mother Tongue and English	0	1	0	-	-	1
TOTAL									20

SEMESTER 2									
	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0201	CC103/Minor 300	Linear Algebra and Optimization	3	0	0	50	50	3
	25-814-0202	CC104/Major 400	Data Structures Using C	3	0	4	50	50	5
	25-814-0203	CC105/Major 300	Computer Organization	4	1	0	50	50	5
	25-814-0204	SEC102/Major 400	Object Oriented Programming using Java	3	0	4	50	50	5
	25-814-0205	SEC103 200	Web Technologies	2	0	2	50	50	3
	25-814-0206	VAC102	Indian Constitution	2	1	0	50	50	3
	25-814-0107	AEC103	Additional Course - Indian or Foreign Language Other than Mother Tongue and English	1	1	0	-	-	2

TOTAL			**26**

SEMESTER 3

Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
25-814-0301	CC201/Minor 300	Probability and Statistics	**3**	**0**	**0**	**50**	**50**	**3**
25-814-0302	CC202/Major 400	Database Management System	**3**	**0**	**4**	**50**	**50**	**5**
25-814-0303	SEC201/Major 400	Python Programming	**3**	**0**	**4**	**50**	**50**	**5**
25-814-0304	CC203/Major 300	Operating System	4	0	2	50	50	5
25-814-0305	DSE201	Interdisciplinary Elective / MOOC	**2**	**0**	**2**	**50**	**50**	**3**
25-814-0306	VAC201	Yoga/Sports/NCC/NSS/Disaster Management	**0**	**1**	**4**	**50**	**-**	**3**
TOTAL								**24**

SEMESTER 4

Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
25-814-0401	CC204 200	Foundations of Entrepreneurship and Startups	**1**	**1**	**0**	**50**	**-**	**2**
25-814-0402	CC205/Major 300	Computer Networks	3	0	4	50	50	5
25-814-0403	CC206/Major 300	Software Engineering	**4**	**0**	**0**	**50**	**50**	**4**
25-814-0404	CC207/Minor 400	Artificial Intelligence and Machine Learning	**3**	**0**	**4**	**50**	**50**	**5**
25-814-0405	DSE202/Minor 300	Professional Elective – II - MOOC	**1**	**0**	**4**	**-**	**100**	**3**
25-814-0406	SEC202 200	Design Thinking and Innovation	**2**	**1**	**0**	**50**	**-**	**3**
TOTAL								**22**

SEMESTER 5

l o	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0501	CC302/Major 400	Design and Analysis of Algorithms	4	0	0	50	50	4
	25-814-0512/ 25-814-0522/ 25-814-0532/ 25-814-0542	DSE301/Major 300	Professional Elective – III	3	0	4	50	50	5
	25-814-0513/ 25-814-0523/ 25-814-0533/ 25-814-0543	DSE302/Major 300	Professional Elective – IV	3	0	4	50	50	5
	25-814-0514/ 25-814-0524/ 25-814-0534/ 25-814-0544	DSE303/Major 300	Professional Elective – V	3	0	4	50	50	5
	25-814-0505	SEC301/Internship 400	Internship/capstone Project	0	0	6	50	50	3
TOTAL									**22**

SEMESTER 6

l o	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0601	CC303/Minor 400	Deep Learning	2	0	4	50	50	4
	25-814-0612/ 25-814-0622/ 25-814-0632/ 25-814-0642	DSE304/Major 300	Professional Elective – VI	3	0	4	50	50	5
	25-814-0603	DSE305/MDE	Professional Elective – VII (MOOC)	3	0		50	50	3
	25-814-0604	AEC301	Soft Skills	0	1	2	50	-	2
	25-814-0605	SEC303/MDE 400	Major Project [Initiated in 5th Semester]	0	0	8	50	50	4
	25-814-0606	SEC304 400	Seminar	-	-	4	50	-	2
TOTAL									**20**

SEMESTER 7 - BCA Honours (Specialization - AI & ML)

No	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0711	MDE401/Minor 400	Internet of Things	3	1	0	50	50	4
	25-814-0712	CC401/Major 400	Reinforcement Learning	3	0	4	50	50	5
	25-814-0713	DSE401/Major 300	Professional Elective – VIII	3	0	4	50	50	5
	25-814-0714	DSE402/Major 300	Professional Elective – IX	3	1	0	50	50	4
	25-814-0715	SEC401 400	Dissertation work	-	-	-	-	-	-
	25-814-0716	SEC402 400	Summer Internship II	0	0	8	50	50	4
	25-814-0717	SEC403/Minor 300	Domain Expertise Workshops	0	0	0	-	-	1
OTAL									23

SEMESTER 7 - BCA Honours (Specialization - Data Science)

No	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0721	MDE401/Minor 400	Internet of Things	3	1	0	50	50	4
	25-814-0722	CC401/Major 400	Social Network Analysis	3	0	4	50	50	5
	25-814-0723	DSE401/Major 300	Professional Elective – VIII	3	0	4	50	50	5
	25-814-0724	DSE402/Major 300	Professional Elective – IX	3	1	0	50	50	4
	25-814-0725	SEC401 400	Dissertation work	-	-	-	-	-	-
	25-814-0726	SEC402 400	Summer Internship II	0	0	8	50	50	4
	25-814-0727	SEC403 300	Domain Expertise Workshops	0	0	0	-	-	1
OTAL									23

SEMESTER 7 - BCA Honours (Specialization - Full Stack Development)

No	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0731	MDE401/Minor 400	Web Application Security and Ethical Hacking	3	1	0	50	50	4
	25-814-0732	CC401/Major 400	Blockchain Fundamentals for Web Developers	3	0	4	50	50	5
	25-814-0733	DSE401/Major 300	Professional Elective – VIII	3	0	4	50	50	5
	25-814-0734	DSE402/Major 300	Professional Elective – IX	3	1	0	50	50	4
	25-814-0735	SEC401 400	Dissertation work	-	-	-	-	-	-
	25-814-0736	SEC402 400	Summer Internship II	0	0	8	50	50	4
	25-814-0737	SEC403 300	Domain Expertise Workshops	0	0	0	-	-	1
OTAL									23

SEMESTER 7 - BCA Honours (Specialization - Cyber Security)

No	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0741	MDE401/Minor 400	Optimization Techniques for Machine Learning	3	1	0	50	50	4
	25-814-0742	CC401/Major 400	Cyber Forensics	3	0	4	50	50	5
	25-814-0743	DSE401/Major 300	Professional Elective – VIII	3	0	4	50	50	5
	25-814-0744	DSE402/Major 300	Professional Elective – IX	3	1	0	50	50	4
	25-814-0745	SEC401 400	Dissertation work	-	-	-	-	-	-
	25-814-0746	SEC402 400	Summer Internship II	0	0	8	50	50	4
	25-814-0747	SEC403 300	Domain Expertise Workshops	0	0	0	-	-	1
OTAL									23

SEMESTER 7 - BCA Honours with Research

No	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
	25-814-0751	CC401/Major 400	Advanced Data Analysis Tools	1	2	4	50	50	5
	25-814-0752	CC402/Major 300	Research Methodology	3	2	0	50	50	5
	25-814-0753	CC403/ RP 400	Research Internship	0	0	8	50	50	4
	25-814-0754	DSEXX/Major 300	Professional Elective – IX	3	0	1	50	50	4
	25-814-0755	DSEXX/Minor 300	Professional Elective – X	3	0	1	50	50	4
	25-814-0756	SEC403 300	Domain Expertise Workshops	0	0	0	-	-	1
OTAL									23

SEMESTER 8 - BCA Honours

No	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
1	25-814-0801	DSE403 300	Professional Elective – X	**3**	**0**	**4**	**50**	**50**	**5**
2	25-814-0802	DSE404 300	Professional Elective – XI	**3**	**0**	**4**	**50**	**50**	**5**
3	25-814-0803	DSE405/Major	Professional Elective – XII - MOOC	**3**		**0**	**-**	**100**	**3**
4	25-814-0804	SEC404 400	Dissertation Work	**0**	**0**	**16**	**50**	**50**	**8**
			TOTAL						**21**

SEMESTER 8 - BCA Honours with Research

No	Course Code	Course Type & Level	Course Title	L	T	P	CE Marks	ESE Marks	Credit
1	25-814-0851	SEC404 400	Dissertation (For Research Track)	**-**	**-**	**-**	**50**	**50**	**18**

	25-814-0852	SEC405	MOOC	2	1	0	-	100	3
			TOTAL						21

SEMESTER 9 (Specialization - Data Science)									
No		**Course Type & Level**	**Course Title**	**L**	**T**	**P**	**CE Marks**	**ESE Marks**	**Credit**
1	25-814-0911	CC501 400	Fog and Edge Computing	**4**	**0**	**0**	**50**	**50**	**4**
2	25-814-0912	DSE501	Professional Elective - XIII - MOOC	**3**	**0**	**0**	**50**	**50**	**3**
3	25-814-0913	DSE502 300	Professional Elective - XIV	**3**	**1**	**0**	**50**	**50**	**4**
4	25-814-0914	DSE503 300	Professional Elective - XV	**3**	**1**	**0**	**50**	**50**	**4**
6	25-814-0915	SEC501 400	Seminar	**0**	**0**	**4**	**50**	**-**	**2**
7	25-814-0916	SEC502 400	Research Project / Industry Project	**-**	**-**	**-**	**-**	**-**	**0**
			TOTAL						**17**

SEMESTER 9 (Specialization - AI & ML)									
No	**Course Code**	**Course Type & Level**	**Course Title**	**L**	**T**	**P**	**CE Marks**	**ESE Marks**	**Credit**
1	25-814-0921	CC501 400	Quantum Computing	**4**	**0**	**0**	**50**	**50**	**4**
2	25-814-0922	DSE501	Professional Elective - XIII - MOOC	**3**	**0**	**0**	**50**	**50**	**3**
3	25-814-0923	DSE502 300	Professional Elective - XIV	**3**	**1**	**0**	**50**	**50**	**4**
4	25-814-0924	DSE503 300	Professional Elective - XV	**3**	**1**	**0**	**50**	**50**	**4**
5	25-814-0925	SEC501 400	Seminar	**0**	**0**	**4**	**50**	**-**	**2**
6	25-814-0926	SEC502 400	Research Project / Industry Project	**-**	**-**	**-**	**-**	**-**	**0**
			TOTAL						**17**

SEMESTER 9 (Specialization - Full Stack Development)									
No	**Course Code**	**Course Type & Level**	**Course Title**	**L**	**T**	**P**	**CE Marks**	**ESE Marks**	**Credit**
1	25-814-0931	CC501 400	Progressive Web App Development	**4**	**0**	**0**	**50**	**50**	**4**
2	25-814-0932	DSE501	Professional Elective - XIII - MOOC	**3**	**0**	**0**	**50**	**50**	**3**
3	25-814-0933	DSE502 300	Professional Elective - XIV	**3**	**1**	**0**	**50**	**50**	**4**
4	25-814-0934	DSE503 300	Professional Elective - XV	**3**	**1**	**0**	**50**	**50**	**4**
5	25-814-0935	SEC501 400	Seminar	**0**	**0**	**4**	**50**	**-**	**2**
6	25-814-0936	SEC502 400	Research Project / Industry Project	**-**	**-**	**-**	**-**	**-**	**0**
			TOTAL						**17**

SEMESTER 9 (Specialization - Cyber Security)									
No	**Course Code**	**Course Type & Level**	**Course Title**	**L**	**T**	**P**	**CE Marks**	**ESE Marks**	**Credit**
1	25-814-0941	CC501 400	Quantum Computing	**4**	**0**	**0**	**50**	**50**	**4**
2	25-814-0942	DSE501	Professional Elective - XIII - MOOC	**3**	**0**	**0**	**50**	**50**	**3**
3	25-814-0943	DSE502 300	Professional Elective - XIV	**3**	**1**	**0**	**50**	**50**	**4**
4	25-814-0944	DSE503 300	Professional Elective - XV	**3**	**1**	**0**	**50**	**50**	**4**
5	25-814-0945	SEC501 400	Seminar	**0**	**0**	**4**	**50**	**-**	**2**
6	25-814-0946	SEC502 400	Research Project / Industry Project	**-**	**-**	**-**	**-**	**-**	**0**
			TOTAL						**17**

*A credit-based MOOC course of minimum 12 weeks duration from SWAYAM/NPTEL/CUSAT or any other platforms approved by the Department.

Students may be permitted to enrol MOOC courses approved by Department Council at any time during the programme and acquire the required credits before completing the programme

SEMESTER 10									
No	**Course Code**	**Course Type & Level**	**Course Title**	**L**	**T**	**P**	**CE Marks**	**ESE Marks**	**Credit**
1	25-814-1001	SEC502 400	Research Project* / Industry Project**	**-**	**-**	**-**	**50**	**50**	**20**
			TOTAL						

* The Research Project option allows students to conduct independent academic research, contributing new insights to their field of study. Students are required to draft and submit one research paper based on their work before program completion. They must also prepare a comprehensive research proposal outlining the project's background, methodology, and future scope. This proposal can serve as a basis for future research if the student pursues further studies.

** The Industry Project option enables students to collaborate with an industry partner to develop a product addressing a real-world need, with clear commercialization potential. Students should work closely with the industry to ensure that the product meets practical standards and industry expectations. They are also required to create a commercialization plan detailing market analysis, monetization strategy, and scalability.

Discipline-Specific Electives (DSE)

1. Data Science

Semester	Course Code	Course Type	Professional Elective
III	25-814-0512	DSE201	Basics of Data Analytics using Spreadsheet
IV	25-814-0513	DSE202	Data Visualization
V	25-814-0514	DSE301	Introduction to Data Science
V	25-814-0514	DSE302	Time Series Analysis
V	25-814-0514	DSE303	Advanced Statistical Modeling and Inference
VI	25-814-0612	DSE304	Big Data Analytics
VI	25-814-0612	DSE305	Image and Video Analytic Fundamentals
VI	25-814-0612	DSE401	Exploratory Data Analysis
VIII	25-814-0713	DSE402	Business Intelligence & Analytics
VIII	25-814-0713	DSE403	Data Mining & Warehousing
VIII	25-814-0713	DSE404	Advanced Data Visualization
VIII	25-814-0713	DSE405	Cloud Computing for Data Analytics
IX	25-814-0714	DSE501	Data Security & Privacy
IX	25-814-0714	DSE502	Graph Analytics and Network Science
IX	25-814-0714	DSE503	Causal Inference and Causal Machine Learning

2. Artificial Intelligence & Machine Learning

Semester	Course Code	Course Type	Professional Elective

III	25-814-0522	DSE201	Feature Engineering
IV	25-814-0523	DSE202	Optimization Techniques
V	25-814-0524	DSE301	Digital Image Processing
V	25-814-0524	DSE302	Natural Language Processing
V	25-814-0524	DSE303	Predictive Analysis
VI	25-814-0622	DSE304	Computer Vision
VI	25-814-0622	DSE305	Evolutionary Algorithm
VI	25-814-0622	DSE401	Explainable AI
VIII	25-814-0723	DSE402	Speech Recognition
VIII	25-814-0723	DSE403	Augmented Reality & Virtual Reality
VIII	25-814-0723	DSE404	Security Aspects of ML
VIII	25-814-0723	DSE405	Machine Learning Operations (MLOps)
IX	25-814-0724	DSE501	Soft Computing
IX	25-814-0724	DSE502	Generative AI
IX	25-814-0724	DSE503	Federated Learning

3. Full Stack Development

Semester	Course Code	Course Type	Professional Elective
III	25-814-0532	DSE201	Essentials of Front-End Web Development
IV	25-814-0533	DSE202	Advanced Database Management
V	25-814-0534	DSE301	Back-End Development Essentials
V	25-814-0534	DSE302	Web APIs and RESTful Services
V	25-814-0534	DSE303	Full Stack Web Development (MERN/MEAN Stack)
VI	25-814-0632	DSE304	Mobile Web Application Development
VI	25-814-0662	DSE305	Introduction to AI and ML for Web
VI	25-814-0662	DSE401	Advanced Web Frameworks
VIII	25-814-0733	DSE402	Mobile Application Developmennt
VIII	25-814-0733	DSE403	Advanced JavaScript
VIII	25-814-0733	DSE404	Microservices Architecture and Cloud Integration
VIII	25-814-0733	DSE 405	Web Security and Secure Coding Practices
IX	25-814-0734	DSE501	Mobile Application Security and Privacy
IX	25-814-0734	DSE502	Responsive Data Analytics for the Web
IX	25-814-0734	DSE503	AI-Driven Personalization for Web Development

4. Cyber Security

Semester	Course Code	Course Type	Professional Elective
III	25-814-0542	DSE201	Foundation for Security & Privacy

IV	25-814-0543	DSE202	Security in Computing (MOOC)
V	25-814-0544	DSE301	Cryptography for Security
V	25-814-0544	DSE302	Security Compliance frameworks and Standards
V	25-814-0544	DSE303	Web Application Security
VI	25-814-0642	DSE304	Natural Language Processing for Threat detection and Analysis
VI	25-814-0642	DSE305	Penetration Testing
VI	25-814-0642	DSE401	Ethical Hacking
VIII	25-814-0743	DSE402	Malware Analysis and Reverse Engineering
VIII	25-814-0743	DSE403	Blockchain Technologies and Smart Contracts
VIII	25-814-0743	DSE404	Cyber Threat Intelligence
VIII	25-814-0743	DSE405	Cloud Security
IX	25-814-0744	DSE501	Wireless and Adhoc Networks (MOOC)
IX	25-814-0744	DSE502	Security Aspects of ML
IX	25-814-0744	DSE503	Ethics in AI

Appendix II - Syllabus
Semester I

CC101	**Discrete Mathematics**	Category	L	T	P	Credit
		CORE	3	0	0	3

Course Outcomes

After completion of this course, the students will be able to:

CO1	Describe basic mathematical structures such as sets, functions, and relations, including their properties and operations.	(Cognitive level: Understand)
CO2	Analyze and interpret the properties of functions and relations, and apply them to model and solve problems in computer science.	(Cognitive level: Apply)
CO3	Apply counting principles and recurrence relations to solve combinatorial and algorithmic problems in computer science.	(Cognitive level: Apply)
CO4	Apply graph theory concepts, including Euler and Hamiltonian graphs, to solve computational problems in computer science.	(Cognitive level: Apply)
CO5	Apply matrix algebra to solve systems of linear equations and compute eigenvalues and eigenvectors.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	3	2			2				3					
CO2	3	3	3		2				3					
CO3	2	3	3		2				3					
CO4	3	2	3	3	2				3					
CO5	3	2	3	3	3				3					

Unit I (10 Hours)	Set, Relation, and Function: Set, Set Operations, Properties of Set Operations, Subset, Venn Diagrams, Cartesian Products. Relations on a Set, Properties of Relations, Representing Relations using matrices and digraphs, Types of Relations, Equivalence Relation, Equivalence relation and partition on set, Closures of Relations, Warshall's algorithm. Functions, properties of functions (domain, range), composition of functions, surjective (onto), injective (one-to-one) and bijective functions, inverse of functions. Some useful functions for Computer Science: Exponential and Logarithmic functions, Polynomial functions, and Ceiling and Floor functions.

Unit II (10 Hours)	Counting and Recurrence Relation: Basics of counting, Pigeonhole principle, permutation, combination, Binomial coefficients, Binomial theorem. Recurrence relations, modeling recurrence relations with examples, like Fibonacci numbers, the tower of Hanoi problem. Solving linear recurrence relation with constant coefficients using characteristic equation roots method.
Unit III (13 Hours)	Elementary Graph Theory: Basic terminologies of graphs, connected and disconnected graphs, subgraphs, paths and cycles, complete graphs, digraphs, weighted graphs, Euler and Hamiltonian graphs. Trees, properties of trees, concept of spanning tree. Planar graphs. Definitions and basic results on the topics mentioned.
Unit IV (12 Hours)	Matrix Algebra: Types of matrices, algebra of matrices–addition, subtraction, and multiplication of matrices, determinant of a matrix, symmetric and skew-symmetric matrices, orthogonal matrix, rank of a matrix, inverse of a matrix, applications of matrices to solve system of linear equations, Eigen values and Eigen vectors, Caley-Hamilton theorem.
Text Books	Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, 2024. (AICTE Recommended Textbook) Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2023. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015. Deo Narsingh, Graph Theory with Application to Engineering and Computer Science, Prentice Hall, India, 1979. Vasishtha A. R. and Vasishtha A. K., Matrices, Krishna Prakashan, 2022.
References	Grimaldi Ralph P. and Ramana B. V., Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education, 2007. Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India, 2019. West Douglas B., Introduction to Graph Theory, Second Edition, Pearson Education, 2015
Web Resources	1. https://nptel.ac.in/courses/106103205 2. https://nptel.ac.in/courses/111101115

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SEC101	**Problem Solving Techniques**	Category	L	T	P	Credit
		CORE	3	0	4	5

Course Outcomes

After completion of this course, the students will be able to:

CO1	Analyze computational problems to identify suitable solution approaches.	(Cognitive level: Analyze)
CO2	Apply structured programming concepts, including sequence, selection, and repetition, to develop efficient algorithms.	(Cognitive level: Apply)
CO3	Write algorithms to solve statistical and mathematical problems.	(Cognitive level: Apply)
CO4	Develop modular and recursive solutions for problems using arrays, matrices, and string functions.	(Cognitive level: Apply)
CO5	Demonstrate debugging skills and implement algorithms using C language constructs, adhering to proper input/output specifications and validation techniques.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	2	2	1	1										
CO2	1	1												
CO3	1	1		1										
CO4	2		2	1			1							
CO5						1								

Unit I (18 Hours)	Problems And Problem Instances. Types of Computational Problems, Classification of Problems, Analysis of Problems, Solution Approaches, Algorithm Development, Analysis of Algorithm, Efficiency, Correctness, Role of Data Structures in Problem Solving, Problem-Solving Steps (Understand the Problem, Plan, Execute, And Review), Breaking the Problem into Subproblems, Input/Output Specification, Input Validation, Pre and Post Conditions.
Unit II (20 Hours)	Structured Programming Concepts: Sequence (Input/Output/Assignment), Selection (If, If-Else). And Repetition (For, While, Do-While) Statements, Control Structure Stacking and Nesting. Different Kinds of Repetitions: Entry Controlled, Exit Controlled, Counter Controlled, Definite, Indefinite and Sentinel-Controlled Repetitions. Pseudocode and Flowcharts. Definition And Characteristics of Algorithms, Standard Algorithm Format. Representation of data types (integer and floating point) in computer memory. Character encoding schemes - ASCII & Unicode. C Language: Implementation of Structured Programming concepts in C.
Unit III (18 Hours)	Problems on Numbers: Extracting Digits of a Number (Left to Right and Right to Left), Palindrome, Prime Number, Prime Factors, Amicable Number, Perfect Number, Armstrong Number, Factorial, Converting Number from One Base to Another. Statistics (Maximum, Minimum, Sum and Average) on a Sequence of Numbers which are Read using Sentinel- Controlled Repetition using only a few Variables. C Language: else-if Ladder, switch Case, Increment/Decrement Operators, break and continue Statements.
Unit IV (19 Hours)	Modular Programming, Top-Down and Bottom-Up Approaches to Problem Solving. Recursion. Problems on Arrays: Reading and Writing of Array Elements, Maximum, Minimum, Sum, Average, Median and Mode. Sequential And Binary Search. Any one Sorting Algorithm. Matrix Operations. C Language: Function Definition and Declaration (Prototype), Role of Return Statement, One Dimensional and Two-Dimensional Arrays. String Functions. Other Operators, Operator Precedence and Associativity. Debugging.
Text Books	Venkatesh, Nagaraju Y, Practical C Programming for Problem Solving, Khanna Book Publishing Company, 2024. AICTE's Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company, 2024. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India, 2015. R G Dromey, How to Solve It by Computer.
References	Brian W. Kernighan and Dennis Ritchie, The C Programming Language, 2nd edition, Pearson, 2015.

	Jeri Hanly and Elliot Koffman, Problem Solving and Program Design in C, 8th edition, Pearson, 2015.

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Problem Solving Techniques: Lab Problems

Converting degrees Celsius to Fahrenheit and vice versa.
Display three input numbers in sorted (non-decreasing) order.
Given a positive integer value n (>= 0) display number, square and cube of numbers from 1 to n in a tabular format.
Given an input positive integer number, display odd numbers from in the range [1,n].
Display first mathematical tables, each table up to 10 rows. Generalize this to display first n (> 0) mathematical tables up to m (m > 0) rows.
Display following patterns of n rows (n > 0), For the below examples n = 5. For each pattern write a separate algorithm/program.

$ $$ $$$ $$$$ $$$$$	$ $$ $$$ $$$$ $$$$$	12345 1234 123 12 1	12345 1234 123 12 1

Display the following patterns of n rows (n > 0), for the below examples n = 5.

####### # # # # # # #######	1 121 12321 1234321 123454321	* ** *** **** *** ** *	* *

Given the first term (a), difference/multiplier (d) and number of terms (n > 0), display the first n terms of the arithmetic/geometric progression.
Display the first n (n > 0) terms of the fibonacci sequence.
Display the first n (n > 0) terms of the Tribonacci sequence.

Given two positive integer numbers n1 and n2 check if the numbers are consecutive numbers of the fibonacci sequence.
Compute approximate value of π considering first n (n > 0) terms of the Taylor series for π.
Compute approximate value of ex considering first n (n > 0) terms of the Taylor series for ex.
Compute approximate value of sin(x)/cos(x) considering first n (n > 0) terms of the Taylor series for sin(x)/cos(x).
Extract digits of an integer number (left to right and right to left).
Given a sequence of digits form the number composed of the digits. Use sentinel controlled repetition to read the digits followed by -1. For example, for the input 2 7 3 2 9 -1 the output number is 27329.
Check if a given positive integer number is a palindrome or not. Compute character grade from the marks (0 ≤ marks ≤ 100) of a subject. Grading Scheme: 80-100 : A, 60 - 79: B, 50 - 59: C, 40-49: D, 0-39: F. Solve this using both else-if ladder and switch case.
Compute the sum of a sequence of numbers entered using sentinel controlled repetition.
Check if a given positive integer number is a prime number or not.
Compute prime factors of a positive integer number.
Check if two positive integer numbers are amicable numbers or not.
Check if a given positive integer number is a perfect number or not.
Check if a given positive integer number Armstrong number or not.
Converting a positive integer number (n > 0) from one base (inputBase) to another base (outputBase) (2 <= input Base, outputBase <= 10). Input number should be validated before converting to make sure the number uses only digits allowed in the input base.
Write a program to display a number in text form. For example If the number is 5432 the output should be “FIVE FOUR THREE TWO”.
Using the grading scheme described in the question 4, Compute how many students awarded each grade and display the frequency as a bar chart (horizontal) using single “*” for each student. Use sentinel controlled repetition (-1 as sentinel value) in reading the students marks. Use else-if ladder/switch case to compute the grade and the corresponding frequency. Sample bar chart when the class has 7-A, 10-B, 3-C, 7-D and 1-F grades.

```
A:
*******
B:
**********
C:
***
D:
*******
F:
*
```

Compute maximum, minimum, sum and average of a sequence of numbers which are read using

sentinel controlled repetition using only few variables.
Compute body mass index, BMI = weight in KGs / (Height in Meters * Height in Meters), Both weight and height values are positive real numbers. Your program should display BMI value followed by whether the person is Underweight, Normal, Overweight or Obese using the below ranges:

BMI Values
Underweight: less than 18.5
Normal: >=18.5 and <25
Overweight: >=25 and < 30
Obese: >= 30

Design a modularized algorithm/program to check if a given positive integer number is a circular prime or not.
Design a modularized algorithm/program to compute a maximum of 8 numbers.
Design a modular algorithm/program which reads an array of n integer elements and outputs mean (average), range (max-min) and mode (most frequent elements).
Design a modular algorithm/program which reads an array of n integer elements and outputs median.
Implement your own string length and string reversal functions.
Design algorithm/program to perform matrix operations addition, subtraction and transpose.
Write a recursive program to count the number of digits of a positive integer number.
Recursive solutions for the following problems:
Factorial of a number.
Display digits of a number from left to right (and right to left).
Compute xy using only multiplication.
To print a sequence of numbers entered using sentinel controlled repetition in reverse order.

CC102	**Logic System Design**	Category	L	T	P	Credit
		CORE	3	0	4	5

Course Outcomes
After completion of this course, the students will be able to:

CO1	Illustrate decimal, binary, octal, hexadecimal and BCD number systems, perform conversions among them and do the operations - complementation, addition, subtraction, multiplication and division on binary numbers	(Cognitive level: Understand)
CO2	Simplify a given Boolean Function and design a combinational circuit to implement the simplified function using Digital Logic Gates	(Cognitive level: Understand)
CO3	Design combinational circuits - Adders, Code Convertors, Decoders, Magnitude Comparators, Parity Generator/Checker	(Cognitive level: Apply)
CO4	Design sequential circuits - Registers, Counters and Shift Registers.	(Cognitive level: Apply)
CO5	Use algorithms to perform addition and subtraction on binary, BCD and floating point numbers. design the Programmable Logic Devices - ROM and PLA.	(Cognitive level: Understand)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO 2
CO1	3	2										3		
CO2	3	3	3	3		3						3		
CO3	3	3	3	3		3						3		
CO4	3	3	3	3		3						3		
CO5	3	2	3									3		

Unit I (18 Hours)	Number systems, Operations & Codes Decimal, Binary, Octal and Hexadecimal Number Systems- Number Base Conversions. Addition, Subtraction, Multiplication and Division of binary numbers. Representation of negative numbers- Complements, Subtraction with complements. Addition and subtraction of BCD, Octal and Hexadecimal numbers. Binary codes- Decimal codes, Error detection codes, Reflected code, Character coding schemes – ASCII, EBCDIC.

Unit II (20 Hours)	Boolean Algebra Postulates of Boolean Algebra. Basic theorems and Properties of Boolean Algebra. Boolean Functions - Canonical and Standard forms. Simplification of Boolean Functions- Using Karnaugh- Map Method (upto five variables), Don't care conditions, Product of sums simplification, Tabulation Method. Digital Logic Gates – implementation of Boolean functions using basic and universal gates.
Unit III (18 Hours)	Combinational Logic Circuits Design Procedure & Implementation of combinational logic circuits- Binary adders and subtractors, Binary Parallel adder, Carry look ahead adder, BCD adder, Code converter, Magnitude comparator, Decoder, Demultiplexer, Encoder, Multiplexer, Parity generator/Checker. Sequential logic circuits: Flip-flops- SR, JK, T and D. Triggering of flip-flops- Master slave flip- flops, Edge-triggered flip- flops. Excitation table and characteristic equation. Registers- register with parallel load. Counter design: Asynchronous counters- Binary and BCD counters, timing sequences and state diagrams. Synchronous counters- Binary Up- down counter, BCD counter.
Unit IV (19 Hours)	Shift registers Shift registers – Serial In Serial Out, Serial In Parallel Out, Bidirectional Shift Register with Parallel load. Ring counter. Johnson counter- timing sequences and state diagrams. Arithmetic algorithms Algorithms for addition and subtraction of binary numbers in signed magnitude and 2's complement representations. Algorithm for addition and subtraction of BCD numbers. Representation of floating point numbers, Algorithm for addition and subtraction of floating point numbers. Programmable Logic devices ROM. Programmable Logic Array(PLA)- Implementation of simple circuits using PLA.
Text Books	M. Morris Mano, Digital Logic & Computer Design, 4/e, Pearson Education, 2013 Thomas L Floyd, Digital Fundamentals, 10/e, Pearson Education, 2009. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007.
References	M. Morris Mano, Michael D Ciletti , Digital Design With An Introduction to the Verilog HDL, 5/e, Pearson Education, 2013. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003

Web Resources	1. https://onlinecourses.nptel.ac.in/noc21_cs64

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AEC101	**General English - I**	Category	L	T	P	Credit
		CORE	1	1	0	2

Course Outcomes

After completion of this course, the students will be able to:

CO1	Demonstrate improved proficiency in listening, speaking, reading, and writing skills by applying vocabulary building, sentence structuring, and oral communication techniques in diverse contexts.	(Cognitive level: Understand)
CO2	Identify and correct common grammatical errors, ensuring clarity, coherence, and conciseness in written communication.	(Cognitive level: Analyze)
CO3	Exhibit effective oral and written communication skills for workplace interactions, including formal presentations, interviews, and everyday professional dialogues.	(Cognitive level: Apply)
CO4	Develop well-structured written content by applying techniques of describing, defining, and classifying ideas, along with creating precise summaries and essays.	(Cognitive level: Apply)
CO5	Integrate English language skills with employability training through interactive activities such as case studies, group discussions, and individual presentations, enhancing both academic and professional competencies.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2

CO1							3		3		3			
CO2							3		3		3			
CO3							3		3		3			
CO4							3		3		3			
CO5							3		3		3			

Unit I (10 Hours)	Vocabulary Building The concept of Word Formation, Root words from foreign languages and their use in English,Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives,Synonyms, antonyms, and standard abbreviations.
Unit II (9 Hours)	Basic Writing Skills Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation,Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely
Unit III (11 Hours)	Identifying Common Errors in Writing Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies Nature and Style of sensible Writing Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion, Writing Practices, Comprehension, Précis Writing, Essay Writing
Unit IV (10 Hours)	Oral Communication (This Module involves interactive practice sessions in Language Lab) Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations, Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations
Text Books	Communication Skills in English (with Lab Manual), Anjana Tiwari, Khanna Book

	Publishing Co., 2023. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
References	Practical English Usage. Michael Swan. OUP. 1995. Remedial English Grammar. F.T. Wood. Macmillan.2007 On Writing Well. William Zinsser. Harper Resource Book. 2001 Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011. 8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

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MDE101	**Indian Knowledge Systems**	Category	L	T	P	Credit
		CORE	2	0	0	2

Course Outcomes

After completion of this course, the students will be able to:

CO1	Demonstrate an understanding of Indian culture, civilization, and its diverse knowledge systems, including traditional arts, sciences, and values, in the context of historical and contemporary relevance.	(Cognitive level: Understand)
CO2	Analyze and appreciate the contributions of ancient Indian systems in fields such as mathematics, astronomy, metallurgy, and architecture, and their influence on modern science and technology.	(Cognitive level: Analyze)
CO3	Explore and apply insights from ancient Indian creative practices, including arts, crafts, and scientific methodologies, to modern academic and professional contexts.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO	PO1	PSO1	PSO2

	1	2	3	4	5	6	7	8	9	0	11	2		
CO1							3							
CO2							3							
CO3							3							

Unit I (10 Hours)	Module 1: Introduction to IKS - Literary activity Introductory lecture on the any eight topics below: 1. Indian Knowledge System, 2. Indian Culture & Civilization, 3. Ancient Indian Chemistry, 4. Ancient Indian Metallurgy, 5. Ancient Indian Mathematics 6. Ancient Indian Astronomy,7. Indian Astronomical Instruments 8. Indian Knowledge System (Upveda: Ayurveda),9. Indian Knowledge System (Upveda: Gandharveda), 10. Indian Knowledge System (Vedangas: Shiksha, Kalpa, Vyakrana), 11. Indian Knowledge System (Vedangas: Jyotisha, Nirukta, Chandas), 12. Indian Architecture I: Sthapatya-Veda, 13. Indian Architecture II: Temples, 14. Indian Architecture III: Town & Planning, 15. Indian Philosophical System
Unit II (20 Hours)	Module 2: Introduction to Creative Practices (Twenty Lectures with at least Five different topics of total session under Creative activity) Introductory lecture on the topics below: 1. Dhatuvada: art of metallurgy 2. Akara jnana: art of mineralogy 3. Vastuvidya: art of engineering 4. Yantramatrika: art of mechanics 5. Takshana: art of carpentry 6. Chalitakayoga: art of practicing as a builder of shrines 7. Raupyaratnapariksha: art of testing silver and jewels 8. Maniraga jnana: art of tinging jewels 9. Sucivayakarma: art of needleworks and weaving 10. Vadya vidya: art of playing on musical instruments 11. Geet vidya : art of singing 12. Nritya vidya: art of dancing 13. Natya vidya: art of theatricals 14. Alekhya vidya: art of painting 15. Viseshakacchedya vidya: art of painting the face and body with color 16. Udakavadya: art of playing on music in water

	17. Manasi kavyakriya: art of composing verse 18. Bhushanayojana: art of applying or setting ornaments 19. Citrasakapupabhakshyavikarakriya: art of preparing varieties of delicious food 20. Dasanavasanangaraga: art of applying preparations for cleansing the teeth, cloths and painting the body 21. Utsadana: art of healing or cleaning a person with perfumes 22. Vastragopana: art of concealment of cloths 23. Balakakridanaka: art of using children's toys 24. Tandulakusumabalivikara: art of preparing offerings from rice and flowers 25. Pushpastarana: art of making a covering of flowers for a bed
Text Books	Textbook on IKS by Prof. B Mahadevan, IIM Bengaluru
References	Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay, 1995. The Cultural Heritage of India. Vol.I. Kolkata:Ramakrishna Mission Publication,1972. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008. Dr. R. C. Majumdar, H. C. Raychaudhuri and Kalikinkar Datta: An Advanced History of India (Second Edition) published by Macmillan & Co., Limited, London, 1953. Rao, N. 1970. The Four Values in Indian Philosophy and Culture. Mysore: University of Mysore. Avari, B. 2016. India: The Ancient Past: A History of the Indian Subcontinent from c. 7000 BCE to CE 1200. London: Routledge.

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VAC101	**Environmental Science and Sustainability**	Category	L	T	P	Credit
		CORE	2	0	0	2

Course Outcomes

After completion of this course, the students will be able to:

CO1	Demonstrate knowledge of fundamental environmental concepts, natural resources, and sustainability principles, and explain their relevance to business operations and decision-making.	(Cognitive level: Understand)
CO2	Analyze issues related to the overutilization of natural resources and propose strategies for conservation, focusing on sustainable practices such as deforestation management, water conservation, energy security, and food security.	(Cognitive level: Analyze)
CO3	Evaluate the structure and functions of ecosystems, the significance of biodiversity, and methods of conservation, emphasizing the importance of India as a mega diverse nation and advocating for sustainable ecosystem management.	(Cognitive level: Evaluate)
CO4	Identify the causes and impacts of environmental pollution, propose sustainable development strategies, and apply cleaner technologies and waste management techniques to minimize environmental harm.	(Cognitive level: Understand)
CO5	Apply principles of environmental ethics and legislation to business practices, demonstrating an understanding of sustainable development goals, ecological economics, and the role of businesses in promoting responsible consumption and addressing environmental challenges.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1							3			3				
CO2							3			3				
CO3							3			3				
CO4							3			3				
CO5							3			3				

Unit I (7 Hours)	Fundamental environmental concepts and their relevance to business operations; Components and segments of the environment, the man-environment relationship, and historical environmental movements. Concept of sustainability; Classification of natural resources, issues related to their overutilization, and strategies for their conservation. Sustainable practices in managing resources, including deforestation, water conservation, energy security, and food security issues. The conservation and equitable use of resources, considering both intergenerational and intergenerational equity, and the importance of public awareness and education.
Unit II (7 Hours)	Ecosystems, Biodiversity, and Sustainable Practices Various natural ecosystems, learning about their structure, functions, and ecological characteristics. The importance of biodiversity, the threats it faces, and the methods used for its conservation. Ecosystem resilience, homeostasis, and carrying capacity, emphasizing the need for sustainable ecosystem management. Strategies for in situ and ex situ conservation, nature reserves, and the significance of India as a mega diverse nation.
Unit III (7 Hours)	Environmental Pollution, Waste Management, and Sustainable Development Various types of environmental pollution, including air, water, noise, soil, and marine pollution, and their impacts on businesses and communities. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Natural and man-made disasters, their management, and the role of businesses in mitigating disaster impacts.
Unit IV (9 Hours)	Social Issues, Legislation, and Practical Applications Dynamic interactions between society and the environment, with a focus on sustainable development and environmental ethics. Role of businesses in achieving sustainable development goals and promoting responsible consumption. Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Environmental justice, refugees, and the resettlement and rehabilitation of affected populations; Ecological economics,human population growth, and demographic changes in India.
Text Books	Poonia, M.P. Environmental Studies (3rd ed.), Khanna Book Publishing Co.

References	Bharucha, E. Textbook of Environmental Studies (3rd ed.) Orient Blackswan Private Ltd. Dave, D., & Katewa, S. S. TextBook of Environmental Studies. Cengage Learning India Pvt Ltd. Rajagopalan, R. Environmental studies: from crisis to cure (4th ed.). Oxford University Press. Miller, G.T. & Spoolman S. Living in the Environment. (20th ed.). Cengage. Basu, M., & Xavier Savarimuthu, S. J. Fundamentals of environmental studies. Cambridge University Press. Roy, M. G. Sustainable Development: Environment, Energy and Water Resources. Ane Books. Pritwani, K. Sustainability of business in the context of environmental management. CRC Press. Wright, R.T. & Boorse, D.F. Environmental Science: Toward A Sustainable Future (13th ed,) Pearson.

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Semester II

CC103	**Linear Algebra and Optimization**	Category	L	T	P	Credit
		CORE	3	0	0	3

Course Outcomes

After completion of this course, the students will be able to:

CO1	Understand fundamental concepts in matrix theory.	(Cognitive level: Understand)
CO2	Apply the concepts of vector spaces, including scalars, vector addition, and scalar multiplication, to solve problems involving vector projections, cosine similarity, and orthogonal vectors.	(Cognitive level: Apply)

CO3	Apply algebraic structures, such as groups and semigroups, to solve problems in computational mathematics and theoretical computer science.	(Cognitive level: Apply)
CO4	Solve transportation problems to determine optimal solutions.	(Cognitive level: Apply)
CO5	Solve linear programming problems using graphical methods, and Simplex methods.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	3	2	1	2	1		1		1				3	2
CO2	3	3	2	2	1		1		1				3	2
CO3	3	3	2	2	1		1		1				3	2
CO4	3	2	2	2	2		1	1	1				3	2
CO5	3	3	3	3	3		1	1	1				3	2

Unit I (11 Hours)	Matrix Analysis Basic Concepts, type of matrices, scalar multiplication, matrix multiplication, properties, Hadamard product, inverse, rank, system of linear equations, linear transformation, eigenvalues & eigenvectors, positive definite matrix, Principle component analysis, Singular value decomposition.
Unit II (11 Hours)	Vector Space Definition, scalars, addition, scalar multiplication, inner product(dot product), vector projection, cosine similarity, orthogonal vectors, normal and orthonormal vectors, vector norm, vector space, subspace, linear combination, linear span, linear independence, basis and dimension.
Unit III (11 Hours)	Abstract Algebra Structures Groups: Definition, examples (e.g., permutation groups), subgroups, cyclic groups, and group homomorphisms. Rings: Definition, examples (e.g., polynomial rings), subrings, ideals, and ring homomorphisms. Fields: Definition, examples (e.g., rational, real, and complex numbers), subfields, and

	field extensions. Applications: Use of groups, rings, and fields in coding theory, cryptography, and other areas.
Unit IV (12 Hours)	Optimization Techniques: Linear programming: Introduction, LP formulation, Graphical method for solving LPs with two variables, Special cases in graphical methods, Simplex method, Duality. Transportation problem: Definition, Linear form, North-west corner method, Least cost method, Vogel's approximation method for finding the feasible solution, MODI method for finding the optimum solution.
Text Books	Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015. Sastry S. S., Introductory Methods of Numerical Analysis, Fifth Edition, PHL, 2022. S.B. Singh, Discrete Structures, Khanna Book Publishing, 2023 (AICTE Recommended Textbook)
References	Rosen Kenneth H. and Krithivasan Kamala, Discrete Mathematics and its Applications, McGraw Hill, India, 2019. Chakravorty J. G. and Ghosh P. R., Linear Programming and Game Theory, Moulik Library, 2017. Sharma J. K., Operations Research: Theory and Applications, Fourth Edition, Macmilllan Publishers, 2007.
Web Resources	1. https://nptel.ac.in/courses/111107127 2. https://www.math.iitb.ac.in/~siva/si50716/SI507lecturenotes.pdf

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CC104	**Data Structures Using C**	Category	L	T	P	Credit
		CORE	3	0	4	5

Course Outcomes

After completion of this course, the students will be able to:

CO1	Write C programs to implement different types of linked lists using dynamic memory allocation.	(Cognitive level: Apply)
CO2	Understand the working of basic search and sort algorithms and implement them.	(Cognitive level: Understand)
CO3	Implement linear data structures using arrays and linked-lists.	(Cognitive level: Understand)
CO4	Implement tree data structures like binary search trees and heaps using arrays and linked-lists.	(Cognitive level: Understand)
CO5	Apply graph theory concepts and hashing techniques, including graph traversal algorithms and collision-handling methods, to problem solving.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	3		1			1								
CO2	2	2		1			1							
CO3	2		1											
CO4	3		1	1										
CO5	3		1											

Unit I (18 Hours)	Arrays, Two-Dimensional and Multi-Dimensional, Pointers, Dynamic Memory Allocation: malloc, calloc, realloc and free functions. Implementation of Linked Lists- Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists. Insertion, Deletion and Search Based on Specific Requirements.
Unit II (20 Hours)	Linear Data Structures: List, Stack, Queue-Array and Linked List Implementation. Conversion of Infix Expression to Postfix Expression and Evaluation of Postfix Expression Using Stack. Searching: Linear Search, Binary search. Sorting Techniques: Insertion Sort, Bubble Sort, Selection Sort, Quick Sort, Merge Sort and Heap Sort.
Unit III (19 Hours)	Non-Linear Data Structures. Trees, Binary Trees, Binary Tree traversal (In Order, Preorder, Postorder). Binary Search Tree: Search, Insertion and Deletion of Elements.

	AVL Tree Operations. Heaps: Insertion and Deletion of Elements, Array Based Implementation of Heaps.
Unit IV (18 Hours)	Graphs: Types, Properties. Representations: Edge List, Adjacency list, Adjacency Matrix. Graph Traversals: Depth First and Breadth First Search. Minimum Cost Spanning Tree Algorithms - Prim's & Kruskal's. Dijkstra's Algorithm, Bellman-Ford Algorithm, All-Pairs Shortest Path Algorithm. Hashing: Hash Tables & Hash Functions. Collision Handling Methods: Separate Chaining, Open Addressing - Linear Probing, Quadratic Probing, Double Hashing)
Text Books	Fundamentals of Data Structures in C, by Ellis Horowitz. SartajSahni and Anderson Freed, Edition 2, 2008, Universities Press. Mastering C, by K.R .Venugopal, S.R Prasad Edition 11, 2011 , Reprint, Tata McGraw-Hill. Introduction to Algorithms, by Thomas H. Cormen, Charles E. Leiserson, Ronald L,Edition 4.
References	The C Programming Language, by Kernighan, Brain W and Ritchie, Dennis M,Edition 2,2007, Prentice Hall. Data Structures using C, by Aaron M.Tanenbaum, Moshe J.Augenstein,1986, Prentice Hall International Inc, Englewood Cliffs, NJ. Data Structures using C, by Aaron M Tanenbaum,Yedidyah Langsam, Moshe J Augenstein, 2009,Prentice Hall International, Inc.

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Data Structures Using C: Lab Problems

Write a program to search for an element in an array using Linear Search and Binary Search.
Write a program to sort an array using Bubble Sort, Selection Sort and Insertion Sort.
Write a program to add two matrices.
Write a program to multiply two matrices.
Write a program to insert an element into a Singly Linked List:
At the beginning
At the end
At a specified position
Write a program to delete an element from a Singly Linked List:
At the beginning
At the end
A specified element
Write a program to perform the following operations in a Doubly Linked List:
Create

Search for an element
Write a program to perform the following operations in a Circular Linked List:
Create
Delete an element from the end
Write a program to implement stack operations using an array.
Write a program to implement stack operations using a linked list.
Write a program to add two polynomials using a linked list.
Write a program to evaluate a postfix expression using a stack.
Write a program to implement simple queue operations using an array.
Write a program to implement circular queue operations using an array.
Write a program to implement circular queue operations using a linked list.
Write a program to perform the following operations on a binary search tree.
Preorder Traversal
Inorder Traversal
Postorder Traversal
Write a program to perform insertion and deletion on a binary search tree.

CC105	**Computer Organization**	Category	L	T	P	Credit
		CORE	4	0	0	4

Course Outcomes
After completion of this course, the students will be able to:

CO1	Identify the basic structure and functional units of a digital computer and the features of RISC architecture.	(Cognitive level: Apply)
CO2	Experiment with the single cycle processor, pipelining, and the associated problems.	(Cognitive level: Apply)
CO3	Utilize the memory organization in modern computer systems.	(Cognitive level: Apply)
CO4	Experiment with the I/O organization of a digital computer.	(Cognitive level: Design)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	3	3	3			1						3		
CO2	3	3	3				1					3		
CO3	3	3	3	3								3		
CO4	3	3	3	3								3		

Unit I (15 Hours)	Von-Neumann Architecture, Instruction set architecture: Arithmetic, logical, shift, and rotate operations. Instruction Set Architecture - Instructions and Instruction Sequencing, Addressing Modes, Subroutines, Condition Codes, Encoding of Machine Instructions CISC vs RISC architectures:- RISC Introduction - Assembly Language, Assembler directives, Assembling. Programming concepts - Program flow, Branching, Conditional statements, Loops, Arrays, Function calls; Instruction execution cycle. Machine language - Instructions, addressing modes, Stored program concept. Evolution of the RISC Architecture.
Unit II (16 Hours)	Register transfer logic: inter register transfer – arithmetic, logic and shift micro operations. Processor logic design: - processor organization – Arithmetic logic unit - design of arithmetic circuit - design of logic circuit - Design of arithmetic logic unit - status register – design of shifter - processor unit – design of accumulator.
Unit III (15 Hours)	Arithmetic algorithms: Algorithms for multiplication and division (restoring method) of binary numbers. Array multiplier , Booth’s multiplication algorithm. Pipelining: Basic principles, classification of pipeline processors, instruction and arithmetic pipelines (Design examples not required), hazard detection and resolution
Unit IV (14 Hours)	Control Logic Design: Control organization – Hard_wired control-microprogram control – control of processor unit - Microprogram sequencer,micro programmed CPU organization - horizontal and vertical micro instructions. Input / Output - External Devices; I/O Modules; Programmed I/O, Interrupt Driven I/O; Direct Memory Access; Embedded I/O Systems - Embedded I/O, General Purpose I/O, Serial I/O, Other Peripherals.
Text Books	Digital Design and Computer Architecture - RISC-V Edition Sarah L. Harris, David

	Harris Morgan Kaufmann 1/e, 2022 Computer Organization and Architecture Designing for Performance William Stallings Pearson 9/e, 2013
Reference Books	Computer Organization and Design : The Hardware/Software Interface: RISC-V Edition David A. Patterson John L. Hennessy Morgan Kaufaman 1/e,2018 Computer Organization and Embedded Systems Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian McGraw Hil 6/e, 2012 Modern Computer Architecture and Organization Jim Ledin Packt Publishing 1/e,2020
	https://archive.nptel.ac.in/courses/106/105/106105163/ https://archive.nptel.ac.in/courses/106/106/106106166/

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SEC102	**Object Oriented Programming using Java**	Category	L	T	P	Credit
		CORE	3	0	4	5

Course Outcomes

After completion of this course, the students will be able to:

CO1	Demonstrate the understanding of fundamentals of Java language and Object Oriented Programming by writing Java programs for solving a given problem	(Cognitive level: Apply)
CO2	Apply object oriented concepts like constructors, inheritance, abstract classes, interfaces and access specifiers to implement real world scenarios in Java	(Cognitive level: Apply)
CO3	Develop robust programs with runtime error handling using Java's exception handling mechanisms	(Cognitive level: Apply)
CO4	Write programs which support concurrency in execution by multithreading	(Cognitive level: Apply)

CO5	Develop event-driven programs and graphical user interfaces using Java Swing, including event handling mechanisms and GUI components.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	3	2	2	1	2		1							
CO2	3	3	3	2	2	1	1				1			
CO3	3	2	3	3		1	2				2			
CO4	3	2	3		3	1	2				2			
CO5	3	3	3	2	3		1		3		1	2		

Unit I (18 Hours)	Overview of Java Language: Java Virtual Machine, Platform Independence. Java Program Structure and Execution, Command Line Arguments. Primitive Data Types, Operators, Control Statements, Arrays and Strings. Fundamentals of Object Oriented Programming. Introduction to Objects and Classes, Properties and Methods, Setting and Getting Object Properties using Methods, Implementation of Simple Scenarios as Java Programs. basic Input and Output.
Unit II (20 Hours)	Object Oriented Concepts: Constructors, Overloading Methods and Constructors. Access Specifiers-Public, Private, Protected, Default. Static and Final. Inheritance: Basics, Method Overriding, Access Specifiers with inheritance, Multi-level Inheritance, Packages, Abstract Classes and Interfaces.
Unit III (18 Hours)	Exception Handling : Fundamentals and Types, Try-Catch, Try with Multiple Catch Clauses, Nested Try Statements, throw, throws, finally, Creating User Defined Exceptions. Multithreaded Programming : The Java Thread Model, Thread states, Creating Threads using Threads Class and Runnable Interface, Creating Multiple Threads, Thread synchronization.
Unit IV (19 Hours)	Event handling & GUI: Event Handling Mechanisms, Event Classes, Sources of Events, Event Listener Interfaces. GUI programming using Swing - Swing Key Features, Swing Controls, Components and Containers, Swing Packages, Event Handling in Swing.
Text Books	Schildt, H. (2022). Java: The Complete Reference. 12th edition. McGraw-Hill

	Education. Object-Oriented Design & Patterns, Cay Horstmann, Second Edition, Wiley 2006
References	E. Balagurusamy, Programming with Java, 6th Edition, McGraw-Hill Education, 2019. Tanweer Alam, Core JAVA, Khanna Book Publishing Company Private Limited, 2015. Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson, 2008. S. Malhotra and S. Choudhary, Programming in Java, 2nd Edition, Oxford University Press, 2014.

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Object Oriented Programming using Java: Lab Problems

Write a program to read two numbers from the user and print their product.

Write a program to print the square of a number passed through command line arguments.

Write a program to send the name and surname of a student through command line arguments and print a welcome message for the student.

Write a java program to find the largest number out of n natural numbers.

Write a java program to find the Fibonacci series & Factorial of a number using recursive and non-recursive functions.

Write a java program to multiply two given matrices.

Write a Java program for sorting a given list of names in ascending order.

Write a Java program that checks whether a given string is a palindrome or not.

Write a java program to read n number of values in an array and display it in reverse order.

Write a Java program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations.

Create a JAVA class called Student with the following details as variables within it.

USN, NAME, BRANCH, PHONE, PERCENTAGE

Write a JAVA program to create a number of Student objects and print the USN, Name, Branch, Phone, and percentage of these objects with suitable headings.

Write a Java program that displays the number of characters, lines and words in a text.

Write a Java program to create a class called Shape with methods called getPerimeter() and getArea(). Create a subclass called Circle that overrides the getPerimeter() and getArea() methods to calculate the area and perimeter of a circle.

Write a Java program to create a class Employee with a method called calculateSalary(). Create two subclasses Manager and Programmer. In each subclass, override the calculateSalary() method to calculate and return the salary based on their specific roles.

Write a Java program using an interface called ‘Bank’ having function rate_of_interest(). Implement this interface to create two separate bank classes SBI and PNB to print different rates of interest.

Include additional member variables, constructors also in classes SBI and PNB.
Write a Java package program for the class Rectangle with properties length and breadth. Import the class from another file and print the area of a rectangle object.
Write a Java program for finding the cube of a number using a package for various data types and then import it in another class and display the results.
Write a Java program for demonstrating the divide by zero exception handling.
Write a Java program that reads a list of integers from the user and throws an exception if there are duplicates.
Create an exception subclass UnderAge, which prints “Under Age” along with the age value when an object of UnderAge class is printed in the catch statement. Write a class exceptionDemo in which the method test() throws UnderAge exception if the variable age passed to it as argument is less than 18. Write the main() method and make it a complete program.

SEC103	**Web Technologies**	Category	L	T	P	Credit
		CORE	1	0	2	2

Course Outcomes
After completion of this course, the students will be able to:

CO1	Demonstrate proficiency in creating structured web pages using HTML	(Cognitive level: Apply)
CO2	Use CSS and Bootstrap framework techniques to make attractive and responsive web pages	(Cognitive level: Apply)
CO3	Develop dynamic and interactive web pages using JavaScript	(Cognitive level: Apply)
CO4	Create and manage AJAX-based web applications	(Cognitive level: Apply)
CO5	Utilize XML and JSON for data structuring and exchange	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO	PO1	PSO1	PSO2

	1	2	3	4	5	6	7	8	9	0	11	2		
CO1	3	2	1	2	3						1			
CO2	3	2	3	2	3						1			
CO3	3	3	3	3	3						1			
CO4	3	3	2	3	2						1			
CO5	3	2	2	2	2						1			

Unit I (7 Hours)	Introduction to HTML: Header Tags, body tags, Paragraph Tags, Tags for Headings, Hyperlinks. Input Tags-Textbox, Radio, Select, Checkbox & Submit. Tags for FORM Creation, TABLE, FORM, TEXTAREA, IFRAME, FIELDSET, ANCHOR. Lists in HTML, Introduction to DIV tag, NAVBAR Design.
Unit II (7 Hours)	Introduction to CSS, types, Selectors, and Responsiveness of a web page. Introduction to Bootstrap, downloads/linking, using classes of Bootstrap, understanding the Grid System in Bootstrap. Introduction to www, Protocols and Programs, Applications and development tools, web browsers, DNS, Web hosting Provider, Setting up of Windows/Linux/Unix web servers, Web hosting in cloud, Types of Web Hosting.
Unit III (7 Hours)	Introduction to JavaScript: Functions and Events, Document Object model traversing using JavaScript. Output System in JavaScript i.e. Alert, throughput, Input box, Console. Variables and Arrays in JavaScript. Date and String handling in JavaScript. Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events.
Unit IV (9 Hours)	Introduction to AJAX, AJAX based Web applications and alternatives of AJAX. Introduction to XML: Uses, Key concepts, DTD schemas, XSL, XSLT, and XSL Elements and transforming with XSLT. Introduction to XHTML. JSON: Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects.
Text Books	Laura Lemay, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications, 2016 Thomas A. Powell, The Complete Reference HTML & CSS, Fifth Edition, 2017

References	Silvio Moreto, Bootstrap 4 By Example, ebook, 2016. Tanweer Alam, Web Technologies, Khanna Book Publishing, 2011.

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Web Technologies: Lab Problems

PART-A

Create your class time table using table tag.

Design a webpage for your college containing description of courses, department, faculties, library etc. using list tags, href tags, and anchor tags.

Create a web page using Frame with rows and columns where we will have header frame, left frame, right frame, and status bar frame. On clicking in the left frame, information should be displayed in the right frame.

Create Your Resume using HTML, use text, link, size, color and lists.

Create a Web Page of a supermarket using (internal) CSS.

Use Inline CSS to format your resume that you have created.

Use External CSS to format your time table created.

Use all the CSS (inline, internal and external) to format the college web page that you have created.

Write an HTML Program to create your college website for a mobile device.

PART – B

Write an HTML/JavaScript page to create a login page with validations.

Develop a Simple calculator for addiction, subtraction, multiplication and division operations using JavaScript.

Use Regular Expressions for validations in Login Page using JavaScript.

Write a Program to retrieve data from a text file and display it using AJAX.

Create XML file to store Student Information like Register Number, Name, Mobile Number, DOB, and Email-Id.

Create a DTD for the scenario given in question 14.

Create an XML scheme for the XML file created against question 14.

Create an XSL file to convert XML file to XHTML file.

Write a JavaScript to illustrate Switch-Case.

10) Write a JavaScript to illustrate any 5 events.

Write a JavaScript using built in JavaScript objects.

Write a program for populating values from JSON text.

Write a program to transform JSON text to a JavaScript object.

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VAC102	**Indian Constitution**	Category	L	T	P	Credit
		CORE	2	0	0	2

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the historical development, foundational principles, and key components of the Indian Constitution, including the Preamble, Fundamental Rights, Duties, and State Policy Principles, and their interpretation in governance.	(Cognitive level: Understand)
CO2	Analyze the structure and functioning of the Union Government, including the roles and powers of the President, Prime Minister, Council of Ministers, and the legislative bodies of Lok Sabha and Rajya Sabha.	(Cognitive level: Analyze)
CO3	Demonstrate an understanding of the roles and responsibilities of state-level authorities, including the Governor, Chief Minister, Council of Ministers, and the State Secretariat, and their interaction with the Union Government.	(Cognitive level: Understand)
CO4	Examine the framework and functioning of local administrative bodies such as District Administration, Municipal Corporations, and Zila Panchayats, highlighting their significance in grassroots governance.	(Cognitive level: Apply)
CO5	Evaluate the functioning and responsibilities of the Election Commission, including the Chief Election Commissioner and State Election Commissions, in ensuring free and fair electoral processes.	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1							3							
CO2							3							
CO3							3							

CO4							3							
CO5							3							

Unit I (7 Hours)	The Constitution - Introduction The History of the Making of the Indian Constitution, Preamble and the Basic Structure, and its interpretation, Fundamental Rights and Duties and their interpretation, State Policy Principles
Unit II (7 Hours)	Union Government Structure of the Indian Union, President – Role and Power, Prime Minister and Council of Ministers, Lok Sabha and Rajya Sabha
Unit III (7 Hours)	State Government Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat
Unit IV (9 Hours)	Local Administration District Administration,Municipal Corporation, Zila Panchayat Election Commission Role and Functioning,Chief Election Commissioner, State Election Commission
Text Books	Ethics and Politics of the Indian Constitution by Rajeev Bhargava, Oxford University Press, New Delhi, 2008 The Constitution of India by B.L. Fadia Sahitya Bhawan; New edition (2017) Introduction to the Constitution of India by DD Basu Lexis Nexis; Twenty-Third, 2018 edition
References	https://www.constitution.org/cons/india/const.html http://www.legislative.gov.in/constitution-of-india https://www.sci.gov.in/constitution https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

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Semester III

CC201	**Probability and Statistics**	Category	L	T	P	Credit
		Core	3	0	0	3

ourse Outcomes

After completion of this course, the students will be able to:

CO1	Describe basic concepts of statistics, including data classification, measures of central tendency, and dispersion, for summarizing and analyzing datasets.	(Cognitive level: Understand)
CO2	Apply correlation and regression techniques to identify relationships between variables and predict outcomes.	(Cognitive level: Apply)
CO3	Apply probability rules and standard probability distributions, such as Binomial, Poisson, and Normal distributions, to model and solve real-world problems.	(Cognitive level: Apply)
CO4	Analyze sampling distributions and statistical inference techniques to estimate population parameters and test hypotheses.	(Cognitive level: Analyze)
CO5	Evaluate the independence of attributes and goodness of fit using chi-square tests to validate statistical models.	(Cognitive level: Evaluate)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	3	2			1		1							
CO2	3	3	2		2		1		1					
CO3	3	3	2	1	3		1							
CO4	3	3	3	2	2		1							

CO5	3	2	2	2	1		1							

Unit I (10 Hours)	Basic concepts of Statistics, qualitative and quantitative data, classification of data, construction of frequency distribution, and diagrammatic representation of data. Measures of Central Tendency: Arithmetic mean, median, and mode—their properties Measures of Dispersion: Range, mean deviation, quartile deviation, variance, and standard deviation.
Unit II (10 Hours)	Correlation: Definition, scatter diagram, types of correlation, measures—Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient. Regression: Linear regression-fitting by least square method and interpretation.
Unit III (13 Hours)	Concepts of probability: Experiment and sample space, events and operations with events, probability of an event, basic probability rules, applications of probability rules, conditional probability. Random Variables: Discrete and continuous random variable, probability distribution of a random variable, probability mass function, probability density function, expectation and variance of a random variable. Standard Probability Distributions: Binomial probability distribution, Poisson probability distribution, Normal probability distribution.
Unit IV (12 Hours)	Sampling Distribution: Concept of Population and Sample, parameter and statistic, sampling distribution of sample mean and sample proportion. Statistical Inference: Estimation and Hypothesis Testing (only concept). Hypothesis Testing for a Single Population: The concept of hypothesis testing, tests involving a population mean and population proportion (z-test and t-test). Chi-square test for independence of attributes and goodness of fit.
Text Books	Manish Sharma, Amit Gupta, The Practice of Business Statistics, Khanna Book Publishing Company, 2010 (AICTE Recommended Textbook) Das N. G., Statistical Methods, Combined Edition, Tata McGraw Hill, 2010. Ross Sheldon M., Introduction to Probability and Statistics for Engineers and Scientists, 6th Edition, Elsevier, 2021. Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearson Education, 2005
References	Pal Nabendu and Sarkar Sahadeb, Statistics: Concepts and Applications, Second Edition, PHI, 2013 Montgomery Douglas and Runger George C., Applied Statistics and Probability for Engineers, Wiley, 2016.

	Reena Garg, Engineering Mathematics, Khanna Publishing House, 2024.
Web Resources	1. https://nptel.ac.in/courses/111106112 2. https://nptel.ac.in/courses/111105041

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CC202	**Database Management System**	Category	L	T	P	Credit
		Core	3	0	4	5

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the role of a Database Management System (DBMS) and its components in managing data for diverse applications.	(Cognitive level: Understand)
CO2	Use SQL queries to perform relational database operations while applying normalization principles.	(Cognitive level: Apply)
CO3	Explain transaction management techniques, concurrency control mechanisms, and indexing strategies and their role in enhancing database performance.	(Cognitive level: Understand)
CO4	Compare NoSQL database models with traditional relational databases and analyze their applications in Big Data technologies.	(Cognitive level: Analyze)
CO5	Explain database security principles and describe advanced topics like OLAP, Data Warehousing, and Data Mining for decision support systems.	(Cognitive level: Understand)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2

CO1	3	2						1						
CO2	3		3		2									
CO3	3			3	2									
CO4		3			3		2							
CO5	3					2		2						

Unit I (18 Hours)	Introduction to Databases: Definition of Data, Database, and DBMS, Overview of Database Applications, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators. Data Models: Introduction to Data Models, Types of Data Models (Hierarchical, Network, Relational, Object-oriented), Importance of Data Models in DBMS. Database Design: Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key,Constraints in a table: Primary Key, Foreign Key, Unique Key, NOT NULL, CHECK, Entity-Relationship (ER) Model,Entities and Entity Sets, Attributes and Relationships,ER Diagrams,Key Constraints and Weak Entity Sets, Extended ER Features,Introduction to the Relational Model and Relational Schema.
Unit II (20 Hours)	Relational Algebra and Calculus: Introduction to Relational Algebra, Operations: Selection, Projection, Set Operations, Join Operations, Division,Tuple and Domain Relational Calculus. Structured Query Language (SQL): SQL Basics: DDL and DML, Aggregate Functions(Min(), Max(), Sum(), Avg(), Count()), Logical operators (AND, OR, NOT), Predicates (Like, Between, Alias, Distinct), Clauses(Group By, Having, Order by, top/limit), Inner Join, Natural Join, Full Outer Join, Left Outer Join, Right outer Join, Equi Join. Advanced SQL: Analytical queries, Hierarchical queries, Recursive queries, Views, Cursors, Stored Procedures and Functions, Packages, Triggers, Dynamic SQL. Normalization and Database Design: Functional Dependencies: Armstrong's Axioms, Definition, Properties (Reflexivity, Augmentation, Transitivity), Types (Trivial, Non-Trivial, Partial and Full Functional Dependency), Closure of Functional Dependencies, Normal Forms(1NF, 2NF, 3NF, BCNF), Denormalization.
Unit III (19 Hours)	Transaction Management:ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support in SQL,Introduction to Crash Recovery, 2PL, Serializability, and

	Recoverability, Introduction to Lock Management, Dealing with Deadlocks. Database Storage and Indexing: Data on External Storage, File Organizations and Indexing, Index Data Structures, Comparison of File Organizations, Indexes and Performance Tuning, Guidelines for Index Selection, Basic Examples of Index Selection
Unit IV (18 Hours)	NoSQL Databases and Big Data: Introduction to NoSQL, Data Models: Document, Key value, Column family, Graph. Uses and Features of NO/SQL document databases. CAP theorem, BASE vs ACID, CRUD operations, MongoDB operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra. Database Security and Advanced Topics: Introduction to Database Security, Access Control, Discretionary Access Control, Introduction to Data Warehousing, OLAP, Data Mining
Text Books	Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, third edition, McGraw – Hill, 2018 Benjamin Rosenzweig, Elena Rakhimov, “Oracle PL/SQL by Example”, fifth edition, Prentice Hall, 2015 Brad Dayley, “NoSQL with MongoDB in 24 Hours”, 1st edition, Sams Publishing, 2024
References	Korth, Silbertz, Sudarshan,” Database System Concepts”, Seventh Edition, McGraw - Hill.(2019) R.P. Mahapatra, Govind Verma, “Database Management Systems”, Khanna Publishing House, 2025.

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CC203	**Operating System**	Category	L	T	P	Credit
		Core	3	0	2	4

Course Outcomes

After completion of this course, the students will be able to:

CO1	Solve synchronization problems in operating systems and issues in distributed systems.	(Cognitive level: Apply)

CO2	Employ process scheduling algorithms and solve process scheduling problems.	(Cognitive level: Analyze)
CO3	Compare various memory management schemes.	(Cognitive level: Apply)
CO4	Solve problems using page replacement algorithms.	(Cognitive level: Apply)
CO5	Compare different access control mechanisms for protection	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	3	3					1							
CO2	3	3					1							
CO3	3	3					1							
CO4	3	3					1							
CO5	3	2					1							

Unit I (18 Hours)	Introduction to Operating Systems, Functions of Operating System,Design Approaches and Types of Advanced Operating Systems. Dual-mode operation, concept of multiprogramming, multiprocessing.Synchronization Mechanisms: Concept of Processes and Threads, Process states and processes state transition diagram, Process control block , process context, CPU Scheduling and Process Scheduling–The Critical Section Problem – Other Synchronization Problems:– Process Synchronization using semaphores & Monitors
Unit II (12 Hours)	Distributed Operating Systems:- Issues in Distributed Operating System, Deadlock prevention, avoidance and detection & recovery - Dead Lock Characterization, Methods for handling Deadlock, Deadlock Prevention, Deadlock avoidance, Deadlock detection & recovery
Unit III (12 Hours)	Memory Management - Types of memory, Memory organization, Address binding Memory Partitioning, Dynamic memory Partitioning, buddy system, Paging, Demand Paging, Segmentation, Page replacement algorithms

Unit IV (18 Hours)	File System - Directory structure - single level, two-level, tree, acyclic graph, general graph; File system mounting,Implementing File System: File system structure - Layered file system, file attributes, File control block; File system implementation Directory Implementation, Allocation Methods. Security and Protection - Goals, Principles in normal OS for security, Access Control models and methods.
Text Books	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, ' Operating System Concepts' 9th Edition, Wiley India 2015 Bhatt P. C. P., An Introduction to Operating Systems: Concepts and Practice, 3/e, Prentice Hall of India, 2010 William Stallings, Operating Systems: Internals and Design Principles, Pearson Global Edition, 2015. Andrew S Tanenbaum, Herbert Bos, Modern Operating Systems, Pearson, 4/e, 2015. D.M.Dhamdhere, “Operating Systems”, 2nd Edition, Tata McGraw Hill, 201.
Web Resources	https://archive.nptel.ac.in/courses/106/105/106105214/

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Semester IV

CC204	**Foundations of Entrepreneurship and Startups**	Category	L	T	P	Credit
		Core	1	1	0	2

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the fundamental concepts of entrepreneurship and family business.	(Cognitive level: Understand)
CO2	Evaluate business ideas and perform feasibility analysis for potential ventures.	(Cognitive level: Evaluate)
CO3	Develop marketing strategies and build operational plans for startups.	(Cognitive level: Create)
CO4	Analyze the startup ecosystem and identify available resources and funding opportunities.	(Cognitive level: Analyze)
CO5	Demonstrate an understanding of the legal, operational, and strategic aspects of managing a startup	(Cognitive level: Apply)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	-	-	-	-	-	-	3	-	-	-	3	-	-	-
CO2	-	-	-	-	-	-	3	-	-	-	3	-	-	-
CO3	-	-	-	-	-	-	3	-	-	-	3	-	-	-
CO4	-	-	-		-	-	3	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	3	-	-	-	3	-	-	-

Unit I (7 Hours)	Introduction to Entrepreneurship & Family Business: Definition and Concept of entrepreneurship, Entrepreneur Characteristics, Classification of Entrepreneurs, Role of Entrepreneurship in Economic Development –Start-ups, Knowing the characteristics of Family business with discussion on few Indian cases of Family Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.
Unit II (7 Hours)	Evaluating Business opportunity: Sources of business ideas and opportunity recognition, Guesstimating the market potential of a business idea, Feasibility analysis of the idea, Industry- competition and environment analysis.
Unit III (7 Hours)	Building Blocks of starting ventures: Low cost Marketing using digital technologies, Team building from scratch, Venture Funding, Establishing the value-chain and managing operations, Legal aspects like IPR and compliances
Unit IV (9 Hours)	Start-up Ecosystem: Know the components of the start-up ecosystem including Incubators, Accelerators, Venture Capital Funds- Angel Investors etc., Know various govt. schemes like Start-up India, Digital India, MSME etc., Sources of Venture Funding available in India, Source of Technology, Intellectual Property management
Text Books	Startup India Learning Program by StartUp India available at www.startupindia.gov.in Entrepreneurship, Rajeev Roy, Oxford University Press Entrepreneurship: Successfully Launching New Ventures by R. Duane Ireland Bruce R.Barringer, Pearson Publishing Family Business Management by Rajiv Agarwal, Sage Publishing
References	Anish Tiwari (2003), “Mapping the Startup Ecosystem in India”, Economic & Political Weekly Ramachandran, K, Indian Family Businesses: Their survival beyond three

	generations,ISB Working Paper Series

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CC205	**Computer Networks**	Category	L	T	P	Credit
		Core	3	0	4	5

Course Outcome

After completion of this course, the students will be able to:

CO1	Describe how computer networks are organized with the concept of layered approach	(Cognitive level: Understand)
CO2	Analyze topological and routing strategies for an IP based network	(Cognitive Level:Analyze)
CO3	Compare protocols of computer networks, and how they can be used to assist in network design and implementation	(Cognitive Level:Analyze)
CO4	Analyze congestion and flow control strategies	(Cognitive Level:Analyze)
CO5	Implement network communication services for client/server and other application layouts (Create)	(Cognitive Level:Analyze)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

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

CO4	3	3											
CO5	3	3				3							

Unit I (18 Hours)	Introduction, history and development of computer networks, network topologies. Layering and protocols. Physical Layer: Different types of transmission media, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, 4B/5B, etc.), MAC Layer: Aloha, CSMA, CSMA/CD, CSMA/CA protocols. Examples: Ethernet, including Gigabit Ethernet and WiFi (802.11), Token Ring, Bluetooth, WiMax
Unit II (18 Hours)	The Services Provided by the Link Layer, Error-Detection and -Correction Techniques-Parity Checks, Checksumming Methods, Cyclic Redundancy Check (CRC), Switched Local Area Networks-Link-Layer Addressing and ARP, Ethernet, Link-Layer Switches, Virtual Local Area Networks (VLANs), Wireless Links and Network Characteristics-CDMA, 802.11 Architecture, 802.11 MAC Protocol, IEEE 802.11 Frame, Mobility in the Same IP Subnet
Unit III (20 Hours)	IPv4 and IPv6 Addressing, IP Address – Subnetting / Super netting, Packet Forwarding with Classfull, Routing Algorithms-The Link-State (LS) Routing Algorithm, Distance-Vector (DV) Routing Algorithm, OSPF, Routing Among the ISPs: BGP-The Role of BGP, Advertising BGP Route Information, Determining the Best Routes, IP-Anycast, SDN Control Plane-SDNController and SDN ControlApplications, OpenFlow Protocol, Data and Control Plane Interaction, ICMP: The Internet Control Message Protocol, Simple Network Management Protocol (SNMP)
Unit IV (19 Hours)	Transport-Layer Services, Multiplexing and Demultiplexing, Connectionless Transport-UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer, Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N (GBN), Selective Repeat, Connection-Oriented Transport, TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control, causes and the Costs of Congestion, Congestion Control, TCP Congestion Control, Classic TCP congestion Control, Network-Assisted Explicit Congestion Notification and Delay-based Congestion Control, Fairness Application-Layer Protocol, Web and HTTP, Electronic Mail in the Internet-SMTP, DNS

Text Books	Kurose and Ross, Computer Networks A systems approach , Pearson Education.7th Edition . 2016. AS Tanenbaum, DJ Wetherall, Computer Networks, 5th Ed., Prentice-Hall, 2010. William Stallings, Data and Computer Communications, Pearson Education.
References	W. R. Stevens.TCP/IP Illustrated, Volume 1: The protocols,Addison Wesley, 1994. G. R. Wright.TCP/IP Illustrated, Volume 2: The Implementation,Addison Wesley, 1995. W. R. Stevens.TCP/IP Illustrated, Volume 3: TCP for Transactions, HTTP, NNTP, and the Unix Domain Protocols,Addison Wesley, 1996. B.A. Forouzan, Data communication & networking, 5th Edition, Tata Mc-Graw Hills.

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CC206	**Software Engineering**	Category	L	T	P	Credit
		Core	3	0	0	3

Course Outcomes

After completion of this course, the students will be able to:

CO1	Explain the evolving role of software and describe various software development process models, including waterfall, incremental, evolutionary, and the unified process.	(Cognitive level: Understand)
CO2	Demonstrate knowledge of agile software development methods and principles, comparing them with traditional plan-driven approaches, and applying agile techniques like Extreme Programming and Scrum.	(Cognitive level: Apply)
CO3	Analyze and apply software requirements engineering processes, including elicitation, specification, validation, and management of both functional and non-functional requirements.	(Cognitive level: Analyze)
CO4	Apply design concepts, develop software architecture, and construct different types of software design models, including	(Cognitive level: Apply)

	class diagrams, sequence diagrams, and use case diagrams, while ensuring testing strategies for quality assurance.	
CO5	Identify and manage software risks using proactive and reactive risk strategies, and develop risk management plans (RMMM) to mitigate risks throughout the software development lifecycle.	(Cognitive level: Evaluate)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	3	2												
CO2			3		2									
CO3		3	3											
CO4			3	2	2									
CO5		3				2		3						

Unit I 10 Hours)	The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process. Agile software development: Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process.
Unit II (12 Hours)	Software Requirements Engineering: Functional and non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management. Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan. Project planning- Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques..
Unit III (13 Hours)	Design: Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams. Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of

	debugging. Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.
Unit IV (10 Hours)	Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability. Release Management: Release planning, development and build plans, release strategies, risk management, and post-deployment monitoring. Product sustenance: Maintenance, updates, End of life, migration strategies.
Text Books	Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTE Recommended Textbook) Software Engineering, Ian Somerville, 9th edition, Pearson education. Software Engineering A practitioner's Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015.
References	Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007 Software Engineering: Principles and Practice Hans van Vliet

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CC207	**Artificial Intelligence and Machine Learning**	Category	L	T	P	Credit
		Core	3	0	4	5

Course Outcomes

After completion of this course, the students will be able to:

CO1	Describe the foundational principles of AI and ML	(Cognitive level: Understand)
CO2	Develop solutions to AI problems using heuristic search, reasoning, and game theory.	(Cognitive level: Create)
CO3	Apply supervised, unsupervised, and reinforcement learning techniques to datasets	(Cognitive level: Apply)

CO4	Build, train, and evaluate ML models using tools su Python, TensorFlow, or PyTorch	(Cognitive level: Apply)
CO5	Demonstrate ethical considerations and critical thinking in interpreting and communicating graph analysis results.	(Cognitive level: Understand)

Mapping of course outcomes with programme outcomes - Low=1, Medium=2, High=3

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PSO1	PSO2
CO1	3	2	1	1	2	-	2	-	1	2	-	-	-	-
CO2	3	3	3	2	3	-	2	-	2	2	2	2	-	-
CO3	3	3	3	3	3	-	2	-	2	2	2	2	-	-
CO4	3	3	2	3	3	-	2	-	2	-	2	2	-	-
CO5	2	2	2	2	2	3	2	-	3	3	-	-	-	-

Unit I (18 Hours)	Introduction to AI and ML: History and evolution, AI techniques, Types of machine learning (supervised, unsupervised, reinforcement), Applications of AI and ML in various domains, Problem-solving using search and reasoning.
Unit II (19 Hours)	Supervised and Unsupervised Learning: Regression, Classification, Decision trees, SVMs, K-NN, Clustering algorithms (k-means, hierarchical), Dimensionality reduction techniques (PCA, t-SNE), Evaluation metrics..
Unit III (20 Hours)	Deep Learning and Reinforcement Learning: Neural networks (MLP, CNN, RNN, LSTM), Backpropagation, Gradient descent, Reinforcement learning concepts, Q-learning, deep Q-networks, Case studies.
Unit IV (18 Hours)	Tools and Ethical Considerations: Hands-on ML using Python libraries (TensorFlow, PyTorch, Scikit-learn), Model deployment, Challenges in AI, Bias, Fairness, Explainability, Societal impacts of AI, Ethical decision-making in AI applications.
Text Books	Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron.

References	Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Pattern Recognition and Machine Learning by Christopher M. Bishop.

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