SBRR Mahajana First Grade College (Autonomous), PG Wing

Pooja BhagavatMemorial Mahajana Education Centre

KRS Road, Metagalli, Mysuru-570016

DEPARTMENT OF MCA
2025-2026

MOTTO

Enter to Learn Depart to Serve

VISION

Build a Strong Research and Teaching Environment that RespondsSwiftly to the Challenges of the 21st Century.

MISSION

1. To provide the highest quality education in Computer Science;
2. To perform research that advances the state-of-the-art in Computer Science;
3. To produce post graduates who are knowledgeable, articulate,principled, innovative, confident, and able to think critically;
4. To be engaged in local, State, and National issues to the benefitof both public and the private sector; and
5. To maintain a diverse college community.

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Master of Computer Application - Regulations

2025-2026

Preamble

Mahajana Post Graduate Centre is an exclusive PG wing of SBRR Mahajana First Grade College (Autonomous). The centre happens to be the largest PG Centre affiliated to University of Mysore.

It was established in July 2003 with the motto "Enter to Learn, Depart to Serve". The Centre is affiliated to University of Mysore and offers Post Graduation programmes in the areas of direct relevance and value to the current generation of students. The Centre offers Post Graduate degree in 12 disciplines and is poised to start new programmes in the years to come.

M.C.A. was started in the year 1999. It is a four semester full-time programme. The course is approved by University Grants Commission and affiliated to the University of Mysore. MCA programme is accredited by All India Council for Technical Education (AICTE).

1. Definitions

Course

Every course offered will have three components associated with the teaching-learning process of the course, namely

(i) Lecture – L (ii) Tutorial- T (iii) Practical - P, where

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

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

In terms of credits, every one hour session of L amounts to 1 credit per semester and a minimum of two hour session of T or P amounts to 1 credit per semester, over a period of one semester of 16 weeks for teaching-learning process. The total duration of a semester is 20 weeks inclusive of semester-end examination.

A course shall have either or all the three components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

The total credits earned by a student at the end of the semester upon successfully completing the course are L + T + P. The credit pattern of the course is indicated as L: T: P.

If a course is of 4 credits then the different credit distribution patterns inL: T: P format could be

4 : 0 : 0,	1 : 2 : 1,	1 : 1 : 2,	1 : 0 : 3,	1 : 3 : 0,
2 : 1 : 1,	2 : 2 : 0,	2 : 0 : 2,	3 : 1 : 0,	3 : 0 : 1,
0 : 2 : 2,	0 : 4 : 0,	0 : 0 : 4,	0 : 1 : 3,	0 : 3 : 1,

The concerned BoS will choose the convenient credit pattern for every course based on the requirement. However, generally, a course shall beof 3 or 4credits.

Different courses of study are labeled and defined as follows:

Core Course

A course which should compulsorily be studied by a candidate as a core requirements termed as a Core course.

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main discipline
/subject of study or from a sister/related discipline / subject which supports the main discipline / subject. In contrast to the phrase Soft Core, a compulsory core course is called a **Hard Core** Course.

Elective Course

Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline / subject of study or which provides an extended scope or which enables an exposure to some other discipline / subject/domain or nurtures the candidate's proficiency/ skill is called an Elective Course. Elective courses may be offered by the main discipline/ subject of study or by sister / related discipline / subject of study. A Soft Core course may also be considered as an elective.

An elective course chosen generally from an unrelated discipline / subject, with an intention to seek exposure is called an **open elective**.

An elective course designed to acquire a special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher is called a **Self Study.**

A core course offered in a discipline / subject may be treated as an elective by other discipline / subject and vice versa.
Project work/Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A project work up to 4 credits is called Minor Project work. A project work of 6 to 8 credits is called Major Project Work. Dissertation work can be of 10-12 credits. A Project/Dissertation work may be a hard core or a soft core as decided by the BoS concerned.

2. Eligibility for Admission

A candidate who has passed any recognized BCA / Bachelor Degree in Computer Science Engineering or equivalent Degree OR Passed B.Sc. / B.Com / B.A. with Mathematics at 10 + 2 level or at Graduation level (with additional bridge courses as per the norms of the concerned University) and obtained an aggregate minimum of 50% marks taken together in all the subjects in all the years of the Degree Examination is eligible for admission to MCA courses. 45% of marks in Qualifying Examination in case of SC, ST and Category-I of Karnataka candidates. NOTE: Rounding off aggregate percent is not permitted.

3. Scheme of Instructions

3.1 A Master's Degree program is of 4 semesters-two year's duration for regular candidates. A regular candidate can avail a maximum of 8 semesters – 4 years (in one stretch) to complete Master's Degree (including blank semesters, if any). Whenever a candidate opts for blank semester(s)/DROP in a course or in courses or is compelled to DROP a course or courses as per the provision of the regulation, he/she has to study the pre-vialing courses

offered by the department as per the prevailing scheme, when he/she continues his/her study.

3.2 A candidate has to earn a minimum of **80 credits**, for successful completion of a Master's degree with a distribution of credits for different courses as given in the following table.

Course Type	**Credits**
Hard Core	44
Soft Core	A minimum of 28, not exceeding 32
Open Elective	A minimum of 4, not exceeding 8

Every course including project work/Dissertation work, practical work, field work, seminar, self-study elective should be entitled as hard core or soft core oropen elective by the BoS concerned.

3.3 A candidate can enroll for a maximum of 24 credits per semester with the approval of the concerned department.

4. Continuous Assessment, Earning of Credits and Award of Grades The evaluation of the candidate shall be based on continuous assessment. TheStructure for evaluation is as follows:

4.1 Assessment and evaluation processes happen in a continuous mode. However, for reporting purposes, a semester is divided into 3 discrete components identified as C1, C2, and C3.

4.2 The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below:

4.2.1 The first component (C1), of assessment is for 25 marks. This will be based on test/ assignment/seminar/quiz/group discussions. During the first half of the semester, the first 50% of the syllabus will be completed. This shall be consolidated during the 8thweek of the semester.Beyond 8th week, making changes in C1 is not permitted.

4.2.2 The second component (C2), of assessment is for 25 marks. This will be based on test/ assignment/seminar/quiz/group discussions. The continuous assessment and scores of second half of the semester will be consolidated during the 16th week of the semester. During the second half of the semester the remaining units in the course will be completed.

4.2.3 The outline for continuous assessment activities for Component-I (C1) and Component-II (C2) will be proposed by the teacher(s) concerned before the commencement of the semester and will be discussed and decided in the respective Departmental Council. The students should be informed about the modalities well in advance. The evaluated courses/assignments during component I (C1) and component II (C2) of assessment are immediately returned to the candidates after obtaining acknowledgement in the register maintained by the concern teacher for this purpose.

4.2.4 During the 18th -20th week of the semester, a semester-end examination of 2 hours duration shall be conducted for each course. This forms the third/final component of assessment (C3) and the maximum marks for the final component will be 50.

4.2.5 In case of a course with only practical component a practical examination will be conducted with two examiners (one internal and one external).
A candidate will be assessed on the basis of:
a) Knowledge of relevant processes
b) Skills and operations involved
c) Results / products including calculation and reporting.
If external examiner does not turn up then both the examiners will be internal examiners. The duration for semester-end practical examination shall be decided by the departmental council.
4.2.6 Scheme of Valuation for Practical Examination:
The student is evaluated for 50 marks in C3 as per the following scheme:
There will be two questions. A candidate has to prepare procedure for both the questions and execute any one of examiner's choice:

Procedure Development	:	10 x 2=20 Marks
Implementation	:	15 x 1=15 Marks
Viva	:	10 Marks
Record	:	05 Marks
Total	**:**	**50 Marks**

*For change of question = 5 Marks will be deducted per question.

4.2.7 If **X** is the marks scored by the candidate out of 50 in C3 in theoryexamination, if **Y** is the marks scored by the candidate out of 50 in C3in Practical examination, and if **Z** is the marks scored by the candidate out of 50 in C3 for a course of (L=0):T:(P=0)type that is entirely tutorial based course, then the final marks
(M) in C3 is decided as per the following table.

L.T.P distribution	Find mark M in C3
L:T:P	$\frac{[(L+T)*X]+[(T+P)*Y]}{L+2T+P}$
L:(T=0):P	$\frac{(L*X)+(P*Y)}{L+P}$
L:T:(P=0)	X
L:(T=0):(P=0)	X
(L=0):T :P	Y
(L=0): (T=0):P	Y
(L=0): T:(P=0)	Z

4.2.8 The details of continuous assessment are summarized in the following table:

Component	**Syllabus in a course**	**Weightage**	**Period of Continuousassessment**
C1	First 50%	25%	First half of the semester To be consolidated by 8th week

C2	Remaining 50%	25%	Second half of the semester. To be consolidated by 16th week
C3	Semester-end examination(All units of the course)	50%	completed during 18th-20thWeek.
Final grades to be announced latest by 24th week			

4.2.9 A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of100 marks (25 +25 + 50).

4.2.10 Finally, awarding the grades should be completed latest by 24th week of the semester.

4.3 **Minor Project/Major Project/Dissertation Evaluation**

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars.

In addition to the regular discussion with the guide. Components of evaluation are as follows:

Component – I (C1): Periodic Progress and Progress Reports (25%)
Component – II (C2): Results of Work and Draft Report (25%)
Component– III (C3): Final Viva-voce and evaluation (50%).

The report evaluation is for 30% and Viva-voce examination is for 20%.

4.4 In case a candidate secures less than 30% in C1and C2 put together in a course, the candidate is said to have DROPPED that course, and such a candidate is not allowed to appear for C3 in that course. In case a candidate's class attendance in a course is less than 75%, the candidate is said to have DROPPED that course, and such a candidate is not allowed to appear for C3 in that course.

Teachers offering the courses will place the above details in the Department Council meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Chairman of the Department before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Controller of Examinations.

4.5 In case a candidate secures less than 30% in C3, he/she may choose DROP/MAKEUP option.

In case a candidate secures more than or equal to 30% in C3, but his/her grade (G) = 4, as per section 4.7 below, then he/she may be declared to have been conditionally successful in this course, provided that such a benefit of conditional clearance based on G=4 shall not be

availed for more than 8 credits for the entire programme of Master's Degree of two years.
A MAKE UP examination for odd semester courses will be conducted along with next regular odd semester examinations and for even semester courses along with a next regular even semester examinations. If a candidate is still unsuccessful, he/she may opt for DROP or again take up MAKE UP examination; however, not exceeding double the duration norm in one stretch from the date of joining the course.

4.6 A candidate has to re-register for the DROPPED course when the courseis offered again by the department if it is a hard core course. The candidate may choose the same or an alternate core/elective in case the dropped course is soft core / elective course. A candidate who is said to have DROPPED project work/Dissertation has to re-register for the same subsequently within the stipulated period. **The details of any dropped course will not appear in the grade card.**

4.7 The grade and the grade point earned by the candidate in the subject will be as given below.

Marks(M)	Grade	Grade Point (GP = V x G)
30-39	4	V*4
40-49	5	V*5
50-59	6	V*6
60-64	6.5	V*6.5
65-69	7	V*7
70-74	7.5	V*7.5
75-79	8	V*8
80-84	8.5	V*8.5
85-89	9	V*9
90-94	9.5	V*9.5
95-100	10	V*10

Here, **P** is the percentage of marks (P = [(C1+C2) +M] secured by a candidate in a course which is rounded to nearest integer. **V** is the credit value of course. **G** is the grade and GP is the grade point.
4.8 A candidate can withdraw any course within in ten days from the date of notification of final results. Whenever a candidate withdraws a paper, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is soft core/open elective.
A DROPPED course is automatically considered as a course withdrawn.

4.9 Overall Cumulative Grade Point Average (CGPA) of a candidate after successful Completion the required number of credits (80) is given by:

CGPA = ΣGP / Total number of credits

5. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPAsecured by the candidate and is given as follows.

CGPA	Numerical Index	Qualitative Index
4 <= CGPA < 5	5	Second Class
5 <= CGPA < 6	6	
6 <= CGPA < 7	7	First Class
7 <= CGPA < 8	8	
8 <= CGPA < 9	9	Distinction
9 <= CGPA < 10	10	

Overall percentage = 10* CGPA or is said to be 50% in case CGPA < 5

6. Medium of Instruction

The medium of instruction shall be English. However, a candidate will be permitted to write the examinations in either English or Kannada. This rule is not applicable to languages.

7. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1 and C2 components, he /she can approach the grievance cell with the written submission together with all facts, the assignments, and test papers etc., which were evaluated. He/she can do so before the commencement of semester- end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the college on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

For every program there will be one grievance cell. The composition of the grievance cell is as follows.

1. The Controller of Examinations ex-officio Chairman / Convener
2. One senior faculty member (other than those concerned with the evaluation of the course concerned) drawn from the department/discipline and/or from the sister departments/sister disciplines.
3. One senior faculty member / course expert drawn from outside the department.

8. Any other issue not envisaged above, shall be resolved by the competentauthority of the autonomous college, which shall be final and binding.

9. Any matter which is not covered under this regulation shall be resolvedas per the College/Mysore University regulations.

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Programme Outcomes – M.C.A.

PO 1: Use emerging tools, techniques and skills necessary for computing in the real World.

PO 2: Identify, formulate and solve complex computing problems to achieve substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domains.

PO 3: Analyze problems, suggest appropriate solutions and justify propositions for effective decision making in the professional field.

PO 4: Develop strong critical thinking skills to assess why certain solutions might not work and to save time in coming up with the right approach in the field of computing.

PO 5: Create, select and apply appropriate techniques and latest Information Technology tools to forecast an outcome by utilizing data that is available.

PO 6: Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practices.

PO 7: Develop and imbibe the principles of ethics and values in profession.

PO 8: Communicate effectively and efficiently as an individual, and as a member, orleader to present the technical knowledge in multi-disciplinary settings.

PO 9: Study and review literature, reports prepare documentation and make inferencesto design better systems.

PO 10: Recognize and realize the need for, and develop an ability to engage in lifelong learning.

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Master of Computer Application

Programme Structure &Syllabus

W.e.f. 2025-2026

List of Hard Core Courses

Sl. No.	Course Title	Credit Pattern			Credits	Course Code
		L	T	P		
1	Discrete Mathematical Structures	4	0	0	4	25BH01
2	Algorithms	3	0	1	4	25BH02
3	Linux Programming	3	0	1	4	25BH03
4	Object Oriented Programming with Java	3	0	1	4	25BH04
5	Professional Communication	3	1	0	4	25BH05
6	Machine Learning with Python	3	0	1	4	25BH06
7	Advanced Computer Networks	3	1	0	4	25BH07
8	Web Technologies	3	0	1	4	25BH08
9	Dissertation Work	0	2	10	12	25BH09

List of Soft Core Courses

Sl. No.	Course Title	Credit Pattern			Credits	Course Code
		L	T	P		
1	Artificial Intelligence	3	1	0	4	25BS01
2	Database Systems	3	0	1	4	25BS02
3	Cloud Security and Privacy	4	0	0	4	25BS03
4	Network Security	3	1	0	4	25BS04
5	Big Data Analytics	3	0	1	4	25BS05
6	Theory of Languages	3	1	0	4	25BS06
7	Probability and Statistics	3	1	0	4	25BS07
8	Internet of Things	3	1	0	4	25BS08
9	Mobile Application Development with Android	3	0	1	4	25BS09
10	Data Indexing Techniques	3	0	1	4	25BS10
11	Information Retrieval	3	0	1	4	25BS11
12	Digital Forensics	3	1	0	4	25BS12
13	Digital Image Processing	3	0	1	4	25BS13
14	Wireless Sensor Networks	3	1	0	4	25BS14
15	Green IT	4	0	0	4	25BS15
16	Intellectual Property Rights	3	1	0	4	25BS16
17	Data Mining	3	1	0	4	25BS17
18	Entrepreneurship Development	3	1	0	4	25BS18
19	Business Intelligence	3	1	0	4	25BS19
20	Ethics, Values And Indian Knowledge System	3	1	0	4	25BS20
21	Cyber Security	3	1	0	4	25BS21
22	Simulation and Modeling	3	1	0	4	25BS22
23	Software Engineering	3	1	0	4	25BS23
24	Research Methodology	3	1	0	4	25BS24
25	NPTEL MOOC COURSE (min. 08 weeks)	0	0	0	4	25BS25

List of Open Elective Courses

Sl. No.	Course Title	Credit Pattern			Credits	Course Code
		L	T	P		
1	Effective Communication and Language Proficiency	3	1	0	4	25BE01
2	E-Commerce	3	1	0	4	25BE02
3	Office Automation	3	1	0	4	25BE03

Note: The list of practical programs provided at the end of courses with Practical is only indicative. The Department may modify, replace, or extend these exercises as per available tools, technologies, and student learning needs. The intent is to illustrate key concepts, not to enforce strict implementation.

BRIDGE COURSE
Fundamentals of Computers and C Programming
Total: 30 hours

Objective: To provide foundational knowledge in computing, mathematics, and programming so that students without a computer science background can successfully make a transition into the MCA curriculum.

Course Outcomes:
At the end of the course the students will be able to:
CO1: Students will be able to identify computer components, understand operating system basics, and perform fundamental file operations in Windows and Linux environments.
CO2: Students will be able to apply basic linear algebra concepts such as matrices, determinants, and vector operations to solve computational problems and understand their applications in computer science.
CO3: Students will be able to design simple algorithms, implement basic programs using control structures, functions, and arrays in C or Python.
CO4: Students will be able to explain and implement basic data structures such as arrays, stacks, queues, and linked lists to solve simple computational tasks.

Unit I — Computer Fundamentals & Operating Systems
Basics of Computers: Generations, Components, and Types, - Number Systems: Binary, Octal, Decimal, Hexadecimal; conversions, Logic Gates & Boolean Algebra basics, Operating Systems Overview: Windows, Linux, MacOS, File systems, file operations, and directory structures.
Practical:
Booting into Linux and Windows, exploring file systems.
File management commands in Linux (ls, cp, mv, rm, chmod, etc.).

Unit II — Linear Algebra for Computing
Vectors and Matrices: Representation, addition, subtraction, multiplication, Determinants and Inverse of a Matrix, Systems of Linear Equations (Gauss elimination method), Eigen values and Eigenvectors — Introduction.
Practical:
1. Implementing vector and matrix operations in Excel/Python.
2. Solving simple systems of equations.

Unit III — Programming Essentials
Introduction to Programming Concepts: algorithms, flowcharts, pseudocode, Variables, Data Types, Operators, Conditional Statements & Loops, Functions and Modular Programming, Basics of Arrays and Strings.
Practical:
1. Writing a simple C/Python program (Hello World, user input)

2. Control structures (if-else, switch, for, while loops)
3. Functions for arithmetic operations.

Unit IV — Introduction to Data Structures

Introduction to Data Structures — definition, types (linear vs non-linear), Arrays: declaration, traversal, insertion, deletion, Strings: basic operations, Linked Lists: concept, advantages over arrays, Stacks and Queues: operations & use cases, Basic searching and sorting (linear search, binary search, bubble sort).

Practical:

1. Implement array operations in C/Python.
2. Write a program for linear and binary search.
3. Simple stack operations (push, pop) using an array.

References:

1. Rajaraman, V. (2018). Fundamentals of computers (6th ed.). PHI Learning.
2. Arumugam, S., & Isaac, G. T. (2010). Linear algebra. SciTech Publications.
3. Kanetkar, Y. (2023). Let us C (17th ed.). BPB Publications.
4. Thareja, R. (2020). Introduction to computing and programming in Python. Oxford University Press India.
5. Tenenbaum, A. M., Langsam, Y., & Augenstein, M. J. (2011). Data structures using C (2nd ed.). Pearson Education India.

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	2	1	1	2	2	2
CO2	3	3	2	2	2	1	1	1	2	2
CO3	3	3	3	3	3	1	1	2	2	3
CO4	3	3	3	3	3	1	1	2	2	3
Weighted Average	3	2.75	2.5	2.5	2.5	1	1	1.75	2	2.5

HC Discrete Mathematical Structures 4:0:0

Total: 45 hours

Objectives:

- Understand the foundational principles of counting, set operations, and basic probability required for solving discrete mathematical problems.
- Understand and analyze logical statements using truth tables, rules of inference, and quantifiers.
- Examine the properties and uses of relations and functions in computing contexts.
- Explore graph concepts and tree algorithms for solving computational problems.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Apply the rules of counting, set theory, and basic probability concepts to compute outcomes in discrete scenarios.

CO2: Construct valid arguments, determine logical equivalence, and prove theorems using direct, indirect, and contradiction methods.

CO3: Model and analyze real-world problems using relations, functions, and matrix representations.

CO4: Solve problems using graph models, construct trees, and apply algorithms like Prim's and Kruskal's for minimal spanning trees.

Unit I: Principles of Counting and Set Theory

The Rules of Sum and Product, Permutation, Combinations, combinations with repetition. Sets and Subsets, Set Operations and the Laws of Set Theory, Counting and Venn, A First Word on Probability, The Axioms of Probability, Conditional Probability: Independence, Discrete Random Variables.

Unit II: Fundamentals of Logic

Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic theory, Logical Implication: Rules of Inference, Argument – Definition, validity and invalidity. The Use of Quantifiers: Quantifiers, Definitions, Argument representation using quantifiers, validity, Proofs of Theorems- Direct and Indirect method - contradiction and contra positive method.

Unit III: Relations and Functions

Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions – Stirling Numbers of the Second Kind, Special Functions, The Pigeon-hole Principle, Function Composition and Inverse Functions.

Relations Revisited: Properties of Relations, Computer Recognition: Zero-One Matrices and Directed Graphs.

Unit IV: Graph Theory

Introduction to Graph Theory: Definitions and examples Sub graphs, Complements, and Graph Isomorphism, Vertex Degree: Euler Trails and Circuits.

Trees: Definitions, Properties and examples rooted trees, Trees and sorting. Weighted Trees and Prefix codes , Spanning trees- minimal spanning tree by Prim's and Kruskal's Algorithm.

Textbook:

1. Discrete and Combinatorial Mathematics, Ralph P. Grimaldi, 5th Edition, Pearson Education.

References:

1. Discrete Mathematical Structures with Applications to Computer Science - Trembley, J.P.and Manohar, RTata McGraw Hill, New Delhi.
2. Discrete Mathematics and Its Applications - Keneth H. Rosen: Fifth Edition, McGrawHill.

Weblink References:

1. Mikel D. Petty, Sets, Combinatorics, and Probability, https://www.uah.edu/images/research/cmsa/pdf/CS214/CS_214_15S_Chapter_4_v30.pdf
2. Basic Counting Principles, https://library.fiveable.me/discrete-mathematics/unit-7/basic-counting-principles/study-guide/NgCG1sGLzPKardYF

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	1	1	1	2	2
CO2	3	3	3	3	2	1	2	2	2	2
CO3	3	3	2	2	3	1	1	1	2	2
CO4	3	3	3	3	3	1	1	1	2	3
Weighted Average	3	3	2.5	2.5	2.5	1	1.25	1.25	2	2.25

HC ALGORITHMS 3:0:1

Total: 60 hours

Objectives:

- Understand the basics of algorithms, which are step-by-step procedures or Formulas for solving problems and understand fundamental data structures.
- Explore different types of algorithms: sorting, searching, graph traversal, and dynamic programming.
- Study algorithm design techniques such as divide and conquer, greedy algorithms, and backtracking.
- Learn about algorithm analysis, including time complexity (Big O notation).
- Recognize the importance of algorithms in computer science, data analysis, and optimization problems.

Course outcomes:

At the end of the course the students will be able to:

CO1: Understand algorithm specification, analyze the performance of algorithms using space and time complexity and apply asymptotic notations to evaluate recursive and non-recursive algorithms.

CO2: Apply divide and conquer, decrease and conquer strategies to solve problems such as binary search, sorting algorithms and topological sorting by evaluating their computational efficiency.

CO3: Develop solutions for optimization problems using greedy strategies and implement algorithms like Knapsack, Minimum Spanning Tree (Prim's and Kruskal's) and Dijkstra's shortest path algorithm.

CO4: Design and implement dynamic programming solutions and backtracking for complex problems such as multistage graphs, all-pairs shortest paths, Travelling Salesperson Problem ,N Queens's and Sum of subset.

Unit I

Introduction to Algorithm: Algorithm Specification, Analysis Framework, Performance Analysis: Space complexity, Time complexity. Asymptotic Notations: Mathematical analysis of non- recursive and recursive Algorithms with Examples. Important Problem Types: Sorting, Searching, Fundamental Data structures: Arrays, Stacks, Queues, Graphs, Trees.

Unit II

Divide and Conquer: General method with Examples, Binary search Finding the maximum and minimum, Merge sort, Quick sort, Advantages and Disadvantages of divide and conquer, Decrease and Conquer Approach: Topological Sort.

Unit III

Greedy Method: General method With Examples, Knapsack Problem, Minimum cost spanning trees, Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm,

Heaps and Heap Sort.

Unit IV

Dynamic Programming: General method with Examples, Multistage Graphs, All Pairs Shortest Paths, Travelling Sales Person problem

Backtracking : General method, N Queen's Problem, Sum of Subset.

Textbooks:

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, 2rd Edition,2009. Pearson.
2. Ellis Horowitz, Satraj Sahni and Rajasekaran, Computer Algorithms/C++, 2nd Edition,2014, Universities Press.

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Edition, PHI.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford (Higher Education).

Weblink References:

1. A Survey on data-efficient algorithms in big era Amina Adadi journal of Big Data volume 8, Article number:24(2021) Cite this article 24k Accesses 96, Citations 74 Altmetric Met https://journalofbigdata.springeropen.com/articles/10.1186/s40537-021-00419-9
2. Scalable Algorithms for Association Mining Mohammed J. Zaki, Member, IEEE Zaki M J (2000) Scalable algorithms for association mining. IEEE Transactions on Knowledge and Data Engineering 12(3):372-390 https://www.researchgate.net/publication/3296896

Course Articulation Matrix:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3	3	3	2	2	1	1	1	2	2
CO2	3	3	3	3	2	1	1	1	2	2
CO3	3	3	3	3	2	1	1	1	2	2
CO4	3	3	3	3	3	1	1	1	2	3
Weighted Average	3	3	3	2.75	2.25	1	1	1	2	2.25

Practicals:

Students are required to design, analyze, and implement various algorithmic techniques using suitable programming languages and tools.

1. Develop recursive and non-recursive solutions for problems such as factorial and Fibonacci series.
2. Apply $O(n^2)$ sorting techniques including Bubble Sort and Insertion Sort.
3. Construct a graph using an adjacency matrix and display its representation.

4. Perform iterative searching techniques such as Linear Search and Binary Search on arrays.
5. Demonstrate basic array operations including insertion, deletion, and traversal.
6. Perform stack operations (Push, Pop, Peek) using array-based representation.
7. Design and execute linear and circular queue operations using arrays.
8. Apply Quicksort algorithm to sort a given dataset using divide and conquer strategy.
9. Use divide and conquer strategy to locate a target element in a sorted array through Binary Search.
10. Apply divide and conquer approach to determine both the maximum and minimum elements in an array with reduced comparisons.
11. Solve problems using greedy techniques, such as the Knapsack Problem and Heapsort algorithm.
12. Solve the Hamiltonian Cycle problem using backtracking approach.

HC LINUX PROGRAMMING 3:0:1

Total: 60 hours

Objectives:

- To introduce students to the fundamentals of UNIX/Linux systems and shell scripting for command-line automation.
- To teach students how to perform file and I/O operations using C and Linux system calls.
- To provide an understanding of Linux process architecture and multithreading using POSIX threads.
- To enable students to implement communication between processes using various IPC mechanisms and socket programming.

Course outcomes:

At the end of the course the students will be able to:

CO1: Students will be able to write and execute shell scripts using basic Linux commands, control structures, and scripting syntax.

CO2: Students will be able to create, manipulate, and manage files and directories, and handle program arguments and environment variables in a Linux environment.

CO3: Students will be able to create and synchronize multiple threads and processes for concurrent execution.

CO4: Students will be able to develop applications that use pipes, shared memory, message queues, semaphores, and sockets for inter-process and network communication.

Unit I

Getting started, An Introduction to UNIX, Linux, and GNU, What Is UNIX? What Is Linux?, The GNU Project and the Free Software Foundation, Linux Distributions, Programming Linux, Linux Programs, Text Editors, The C Compiler, The Shell as a Programming Language, Basic Linux Commands, Interactive Programs, Creating a Script, Making a Script Executable, Shell Syntax, Variables, Conditions, Control Structures, Functions, Commands, Command Execution.

Unit II

Working with Files, The Standard I/O Library, Formatted Input and Output, File and Directory Maintenance, Scanning Directories, The Linux Environment- Program Arguments, Environment Variables, Time and Date, Temporary Files.

Unit III

Process Structure, Starting New Processes, Signals, POSIX Threads, What Is a Thread? A First Threads Program, Simultaneous Execution, Synchronization- Synchronization with Semaphores.

Unit IV

Inter-Process Communication: Pipes, What Is a Pipe?, Process Pipes, Sending Output to popen, The Pipe Call, Parent and Child Processes, Named Pipes: FIFOs- Accessing a FIFO, Opening a FIFO with open, Semaphores, Shared Memory, and Message Queues. Sockets- Socket Connections, Types, Creating a socket, Naming a socket, Closing a socket.

References:

1. Neil Matthew, Richard Stones, Beginning Linux® Programming, Wiley Publishing, Inc. 4th Edition.
2. Advanced Programming in the UNIX Environment" by W.Richard Stevens, Stephen A. Rago.

Weblink References:

1. Research on Linux Trusted Boot Method Based on Reverse Integrity Verification, Chenlin Huang, Chuanwang Hou, Huadong Dai**,** Hindawi Publishing Corporation Advances in Computer Engineering Volume 2015, Article ID 261094, 8 pages. http://dx.doi.org/10.1155/2015/261094, https://onlinelibrary.wiley.com/doi/full/10.1155/2016/4516596
2. Title: Linux Low-Latency Tracing for Multicore Hard Real-Time Systems, Raphaël Beamonte**,** Hindawi Publishing Corporation Scientific Programming Volume 2016, Article ID 4516596, 12 pages.http://dx.doi.org/10.1155/2016/4516596 https://onlinelibrary.wiley.com/doi/full/10.1155/2015/261094
3. Linux “man” pages and “info” pages. https://man7.org/linux/man-pages/man1/man.1.html
4. The Linux Documentation Project : http://www.tldp.org/

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	1	2	1	-	1	2	1
CO2	3	2	3	2	2	1	-	-	1	1
CO3	3	2	2	2	2	-	-	1	1	1
CO4	3	2	3	3	3	2	-	-	3	1
Weighted Average	3	2.25	2.5	2.5	2.25	1	-	0.5	1.75	1

Practicals:

Students are required to implement Linux-based programming solutions using shell scripting, C programming, and system programming interfaces.

1. Programming Environment – Linux programs, text editors, C compiler usage, and shell as a programming language.
2. Basic Linux Commands and Shell Scripting – Command execution, interactive programs, creating and executing scripts.
3. Shell Syntax and Programming Constructs – Variables, conditions, control structures, functions, and built-in commands.
4. File Handling – Standard I/O library, formatted input/output, file and directory maintenance, and scanning directories.
5. Linux Environment Variables – Program arguments, environment variables, time/date handling, and temporary files.
6. Process Management – Process structure, starting new processes, and signal handling.
7. POSIX Threads – Creating and managing threads, simultaneous execution, and thread programming basics.
8. Thread Synchronization – Semaphore-based synchronization techniques.
9. Inter-Process Communication (IPC) – Pipes – Concepts, process pipes, popen, pipe call, and parent-child communication.
10. Named Pipes (FIFOs) – FIFO access, opening FIFOs, and data exchange between processes.
11. System V IPC – Semaphores, shared memory, and message queues for process communication.
12. Sockets Programming – Socket types, creating, naming, and closing sockets for network and inter-process communication.

HC OBJECT ORIENTED PROGRAMMING WITH JAVA 3:0:1

Total: 60 hours

Objectives:

- Introduce the fundamentals of Java programming and core object-oriented principles.
- Provide knowledge on creating and using classes, objects, arrays, methods, and constructors in Java.
- Develop understanding of inheritance, polymorphism, abstraction, and effective use of packages.
- Build proficiency in exception handling, multithreading, and applying the Collection Framework for efficient data handling.

Course outcomes:

At the end of the course the students will be able to:

CO1: Understand and apply the basic concepts of Java programming, including OOP principles, program structure, data types, operators, and control flow statements.

CO2: Demonstrate the ability to use Java arrays, define and instantiate classes/objects, declare and overload methods, and implement constructors.

CO3: Apply the concepts of inheritance and polymorphism in Java, implement abstract classes and interfaces, and organize code using packages with appropriate access control.

CO4: Handle exceptions effectively in Java, implement basic multithreading concepts, and utilize core components of the Collection Framework for efficient data management.

Unit I

Introduction to Java : What is Java?, Basic Object-Oriented Programming Principles, Brief History of Java, Key Features of Java, Java Virtual Machine ,Basic Structure of a Java Program, Compilation and Execution Process, Variables and Data Types (focus only on primitive types),Keywords and Identifiers, Operators and Expressions (basic arithmetic, relational, logical),Type Conversion and Casting (brief intro) Control Flow Statements.: Conditional Statements: if, if-else, switch, Looping Statements: for, while, do-while, Branching: break, continue, return.

Unit II

Arrays: Introduction to Arrays**,** One-Dimensional Arrays, Two-Dimensional Arrays.

Classes and Objects: Understanding Classes and Objects, Declaring and Creating Classes, Instantiating and Initializing Objects, Basic Use of Class Members (variables and methods)

Methods in Java: Declaring and Using Methods**,** Method Overloading

Constructors: Constructors and Their Purpose, Constructor Overloading

Unit III

Inheritance in Java Concept of Inheritance**,** Method Overriding**,** Using super Keyword Using final Keyword, Types of Inheritance.

Polymorphism: Concept of Polymorphism (compile-time and runtime), Difference between Method Overloading and Method Overriding, Abstract Classes (partially implemented classes), Interfaces (achieving abstraction and multiple inheritance)

Packages: Creating Custom Packages, Importing and Using Packages**,** Access Modifiers and Access Protection (public, protected, default, private)

Unit IV

Exception Handling: Need for Exception Handling**,** Types of Exceptions: Checked vs Unchecked**,** Handling Exceptions: try-catch Block**,** finally Block**, throw** Keyword**,** throws Clause.

Multithreading in Java: Introduction to Multithreading**,** Thread Life Cycle ,Creating Threads using Runnable Interface and Thread Class**,** Thread Synchronization (concept only)**,** Thread Priority (basic understanding) Communication between Threads (basic methods like wait (), notify ()).

Collection Framework Overview: Purpose and Importance of Collections**,** Core Collection Interfaces:List (ArrayList, LinkedList)**,** Set (HashSet, TreeSet)**,**Map (HashMap), Basic Operations on Collections**,** Accessing Collections using Iterators (basic usage)

Textbooks:

1. Y Daniel Liang, Introduction to Java Programming (Comprehensive Version), Seventh Edition, Pearson.
2. Sachin Malhotra, Saurabh Chaudhary, Programming in Java, Oxford University Press.
3. Doug Lowe, Joel Murach, Andrea Steelman, Murach's Beginning Java 2, SPD.
4. Herbert Schild, The Complete Reference, Java 2 (Fourth Edition), TMH.

References:

1. Horstmann, Cornell, Core Java Volume-I Fundamentals, Eight Edition, Pearson Education.
2. D. S. Malik, Java Programming, Cengage Learning.

Weblink References:

1. A Review on Java Programming Language Desiree D. Martinez, Axl Heart P. Remegio, Darllaine R. Lincopinis https://www.researchgate.net/publication/371166744_A_Review_on_Java_Programming_Language
2. Core Java : An Object Oriented Language Ananya Anikesh Department of Information & Technology Engineering Dronacharya College Of Engineering, Khentawas, Gurgaon. https:// ijirt.org/master/publishedpaper/IJIRT143039_PAPER

3. Exception Handling: A Field Study in Java and .NET Bruno Cabral, Paulo Marques CISUC, Department of Informatics Engineering, University of Coimbra, Portugal {bcabral, pmarques}@dei.uc.ptfile:///C:/Users/Administrator/Downloads/Exception_Handling_A_Field_Study_in_Java_and_NET.pdf

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	1	1	1	1	1	1	1
CO2	3	2	3	3	1	1	1	1	1	1
CO3	3	3	3	3	1	1	1	1	1	1
CO4	3	2	1	1	2	1	1	1	1	1
Weighted Average	3	2.25	2	2	1.25	1	1	1	1	1

Practicals:

Students are required to implement object-oriented programming concepts using Java to build modular, reusable, and efficient applications.

1. Java Basics – Structure of a Java program, compilation and execution, variables, primitive data types, keywords, identifiers, operators, type conversion, and casting.
2. Control Flow Statements – Conditional statements (if, if-else, switch), looping (for, while, do-while), and branching (break, continue, return).
3. Arrays – One-dimensional and two-dimensional arrays, declaration, initialization, and basic operations.
4. Classes and Objects – Defining classes, creating objects, initializing members, and accessing methods and variables.
5. Methods in Java – Declaring, invoking, and overloading methods for code reusability.
6. Constructors – Purpose, declaration, initialization, and constructor overloading.
7. Inheritance – Concept, method overriding, super keyword, final keyword, and single inheritance, abstract classes, and interfaces.
8. Polymorphism – Compile-time and runtime polymorphism.
9. Packages and Access Modifiers – Creating and importing packages, and using public, protected, default, and private for access control.
10. Exception Handling – try-catch-finally, throw, and throws for robust error handling.

11. Multithreading – Creating threads using Thread and Runnable, synchronization concepts,
    priorities, and basic inter-thread communication (wait(), notify()).
12. Collections Framework – Purpose, core interfaces (List, Set, Map), implementations (ArrayList, LinkedList, HashSet, TreeSet, HashMap), basic operations, and iterator usage.

HC PROFESSIONAL COMMUNICATION 3:1:0

Total: 45 hours

Objectives:

- To help students understand the basic principles, types, processes, and barriers of communication in professional and organizational contexts.
- To develop students' ability to listen actively and respond appropriately in various communication situations.
- To enhance students' verbal and non-verbal communication skills for presentations, discussions, and interviews.
- To develop students' competence in writing professional and creative content, including memos, emails, and reviews.

Course outcomes:

CO1: Students will be able to explain the communication process and identify common barriers, improving their overall communication effectiveness in academic and workplace environments.

CO2: Students will demonstrate improved listening skills by identifying types of listening and applying active listening techniques in practical settings.

CO3: Students will be able to confidently deliver different types of speeches and effectively participate in group discussions and interviews using appropriate speaking techniques.

CO4: Students will be able to construct well-structured paragraphs and write various professional documents like emails, memos, advertisements, and reviews with clarity and coherence.

Unit I: Fundamentals of Communication

Introduction, Definition, Process, Importance, Purpose, Different forms of Communication, Communication Network in an Organization, Barriers to Communication.

Unit II: Listening Skills

Introduction, Poor Listening Vs Effective Listening, Advantages, Process, Types, Barriers, Five steps to Active Listening.

Unit III: Speaking Skills

Non Verbal Communication, Group Discussions, Job Interviews, Public Speaking, selecting an appropriate method, Art of Persuasion, Visual Aids and Illustrations, Delivering Different types of speeches.

Unit IV: Writing Skills

Structure of a paragraph, Construction of a paragraph, features, Memos, Email Writing, Advertising, Movie, Book Review.

Textbook:

1. Sanjay Kumar, Pushpalata, Communication Skills, II Edition, Oxford University Press, 2019.

References:

1. Kavita Tyagi, Padma Misra, Professional Communication, PHI Learning, 2010.
2. Bovee et al, Business Communication Today, 15th Edition Pearson, 2021. https://www.pearsonhighered.com/assets/preface/0/1/3/5/0135891809.pdf
3. Lehman, Dufrene, Sinha, BCOM, Business Communication, Cengage Learning.

Weblink References:

1. Ana Cuic Tankovic, et.al., Measuring the importance of communication skills in stourism, Taylor & Francis Online, 2023. https://www.tandfonline.com/doi/full/10.1080/1331677X.2022.2077790
2. Communicating effectively, Queensland Government, 2022. https://www.business.qld.gov.au/running-business/marketing-sales/sales/communicating-effectively
3. George BUCĂŢA, The Role of Communication in Enhancing Work Effectiveness of an Organization, Land Forces Academy Review Vol. XXII, No 1(85). https://www.researchgate.net/publication/316360042_The_Role_of_Communication_in_Enhancing_Work_Effectiveness_of_an_Organization

Course Articulation Matrix:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	2	2	2	1	2	2	3	2	2
CO2	1	1	2	3	1	1	1	3	2	2
CO3	1	2	2	2	1	2	2	3	2	3
CO4	2	2	3	3	2	2	2	3	3	3
Weighted Average	1.25	1.75	2.25	2.5	1.25	1.75	1.75	3	2.25	2.5

HC MACHINE LEARNING WITH PYTHON 3:0:1

Total: 60 hours

Objectives:

- Understand the basics of machine learning, Python tools, and data exploration techniques.
- Explain the concepts and steps involved in building linear regression models.
- Introduce classification techniques and evaluation methods for binary classification problems.
- Understand advanced ML libraries and unsupervised learning techniques like clustering

Course Outcomes:

At the end of the course the students will be able to:

CO1: Use Python and Anaconda to prepare, clean, and visualize data using descriptive analytics.

CO2: Build and evaluate simple and multiple linear regression models.

CO3: Apply logistic regression and decision tree models to solve classification problems and interpret performance metrics.

CO4: Use unsupervised learning techniques to cluster data and Apply Scikit library for Machine Learning.

UNIT I: Introduction to Machine Learning

Introduction to Analytics and Machine Learning, Need for Machine Learning, Framework for Developing Machine Learning Models, Python for Machine Learning, Python Stack for Data Science, Getting Started with Anaconda Platform, Introduction to Python. Descriptive Analytics: Working with Data Frames in Python, Handling Missing Values and Exploration of Data using Visualization.

UNIT II: Linear Regression

Simple Linear Regression, Steps in Building a Regression Model, Building Simple Linear, Regression Model, Model Diagnostics, Multiple Linear Regression.

UNIT III: Classification Problems

Classification Overview, Binary Logistic Regression, Credit Classification, Gain Chart and Lift Chart, Classification Tree (Decision Tree Learning).

UNIT IV: Advanced Machine Learning and Clustering

Scikit-Learn Library for Machine Learning Advanced Machine Learning Algorithms. Clustering: Overview, How Does Clustering Work?, K-Means Clustering, Creating Product Segments Using Clustering, Hierarchical Clustering.

References:

1. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley India Pvt. Ltd., 2019.

2. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The PragmaticBookshelf,2013.
3. Learning with Python: How to Think Like a Computer Scientist Paperback – Allen Downey, Jeffrey Elkner, 2015.
4. Python Data Science Handbook: Essential tools for working with data, Jake Vanderplas, O'Reilly Publishers, 1st Edition.
5. Hands-On Machine Learning with Scikit-Learn and Tensor Flow Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly Publisher, I edition,2017.

Weblink References:

1. Research on Machine Learning in Python: Main Developments and Technology Trends in DS, ML, and AL
   https://www.researchgate.net/publication/359418005_Research_on_Machine_Learning_in_Python_Main_Developments_and_Technology_Trends_in_DS_ML_and_AL/link/623b1ea53818892e0a6bb876/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19
2. Critical review of machine learning integration with augmented reality for discrete manufacturing
   https://www.researchgate.net/publication/358279649_Critical_review_of_machine_learning_integration_with_augmented_reality_for_discrete_manufacturing
3. Machine learning : Algorithms, real-world Applications and Research Directions
   https://link.springer.com/article/10.1007/s42979-021-00592-x

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	1	1	3	3
CO2	3	3	3	3	3	2	1	1	3	3
CO3	3	3	3	3	3	3	1	1	3	3
CO4	3	3	3	3	3	2	1	1	3	3
Weighted Average	3	3	3	3	3	2.25	1	1	3	3

Practicals:

Students are required to design, implement, and evaluate machine learning models using Python and related data science libraries.

Creating and manipulating DataFrames using pandas.

1. Handling missing values and outliers.
2. Exploratory Data Analysis (EDA) using matplotlib and seaborn.
3. Implementing Simple Linear Regression using scikit-learn.

4. Implementing Multiple Linear Regression and evaluating model performance.
5. Performing Model Diagnostics (residual analysis, R^2, adjusted R^2).
6. Implementing Binary Logistic Regression for classification tasks.
7. Creating Gain Chart and Lift Chart for classification evaluation.
8. Building a Decision Tree Classifier and visualizing it.
9. Implementing K-Means Clustering for customer segmentation.
10. Implementing Hierarchical Clustering and creating dendrograms.
11. Applying an Advanced ML Algorithm (e.g., Random Forest, SVM) with scikit-learn.

Mini Project

End-to-end Machine Learning pipeline: data pre-processing → model building → evaluation → visualization.

HC ADVANCED COMPUTER NETWORKS 3:1:0

Total: 45 hours

Objectives:

- To understand the fundamental concepts of data communication, networking models, protocols, and network devices.
- To understand transport layer protocols, congestion control, and performance aspects of TCP/IP networks.
- To explore TCP/IP performance challenges and enhancements in wireless network environments.
- To create IP security, malware types, and network attack prevention.

Course Outcomes:

At the end of the course the students will be able to:

CO1: To gain expertise in networking concepts, protocols, and devices for effective network design and implementation.

CO2: To analyze and evaluate TCP/IP transport protocols and their network performance.

CO3: To analyze TCP/IP behavior over wireless networks and apply techniques to improve its performance.

CO4: Comprehend IP security and counter malware and DDoS attacks.

Unit I: Introduction

Uses of Computer Network, Topology & Types of Topologies, types of networks (LAN, MAN, WAN), Types of Communications (Asynchronous and Synchronous), Modes of Communications (simplex, half duplex, full duplex), Networking models The OSI model, Layers in OSI model, TCP/IP protocol suite, Networking Devices- Hubs, Switches, Bridges, Routers, Gateways, NICs (Network Interface Card).

Unit II: Transport Layer

The Transport Service, Congestion Control, History of TCP/IP, TCP Applications and Services, Motivation for Performance Study of TCP/IP, TCP Performance, TCP/IP Fundamentals, TCP, UDP, IP, Performance Measurements of TCP/IP Networks

Unit III: **TCP/IP**

TCP/IP Performance over Wireless Networks, Wireless Networks, Generic characteristics, Wireless Local Area Networks, Cellular Communications Networks, TCP Performance Issues over Wireless Links, Inappropriate Reduction of Congestion Window, Throughput Loss in WLANs, Throughput Loss in Cellular Communication Systems, Improving TCP Performance over Wireless Links, Splitting TCP Connections, Snooping TCP at Base Stations, Notifying the Causes of Packet Loss, Adding Selective Acknowledgments to TCP.

Unit IV: IP & System Security

Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations- Authentication plus Confidentiality, Basic Combinations of Security Associations, Malicious Software, Types, Viruses, Antivirus Approaches, Distributed denial of service (DDoS) attacks.

References:

1. Data Communications and Networking, Behrouz A Forouzan, 4th Edition, Tata McGraw-Hill.
2. Computer Networks, Andrew S Tanenbaum, David. J. Wetherall, Pearson Education.
3. High Performance TCP/IP: Networking Concepts, Issues, and Solutions, Mahbub Hassanand Raj Jain, IST Edition, PHI Learning.
4. Network Security Essentials: Applications and Standards, William Stallings, 4th Edition,Prentice Hall
5. https://www.pearsonhighered.com/assets/samplechapter/0/7/8/9/0789732548.pdf

Weblink References:

1. Cooperative Game-Based Resource Allocation Scheme for Heterogeneous Networks with eICIC Technology, Sungwook Kim, Hindawi Journal of Computer Networks and CommunicationsVolume 2023, Article ID 5526441, 14 pages
   https://www.hindawi.com/journals/jcnc/2023/5526441/
2. An Optimized and Energy-Efficient Ad-Hoc On-Demand Distance Vector Routing Protocol Based on Dynamic Forwarding Probability (AODVI) 1. Hailu Gizachew Yirga, 2. Gizatie Desalegn Taye, Hindawi Journal of Computer Networks and Communications Volume 2022, Article ID 5750767, 13 pages
   https://www.hindawi.com/journals/jcnc/2022/5750767/
3. Zigbee Wireless Sensor Networks: Performance Study in an Apartment-Based Indoor Environment, 1. Biswajit Kumar Dash, 2. Jun Peng, Hindawi Mathematical Problems in Engineering
   https://www.hindawi.com/journals/jcnc/2022/2144702/

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	-	1	1	1	1
CO2	3	3	2	2	2	2	1	1	1	2
CO3	3	3	2	3	2	2	1	1	1	2
CO4	3	2	2	3	3	2	1	1	2	2
Weighted Average	3	2.5	2	2.25	1.75	1.5	1	1	1.25	1.75

HC WEB TECHNOLOGIES 3:0:1

Total: 60 hours

Objectives:

- Introduce the foundational concepts of the internet, HTML structure, and how to create well-formatted web pages.
- Provide knowledge of styling techniques using Cascading Style Sheets to enhance the appearance and layout of web pages.
- Develop interactive web pages using JavaScript by manipulating the DOM and handling user events efficiently.
- Familiarize students with server-side scripting using PHP, XML/JSON data handling, and web database interaction.

Course outcomes:

At the end of the course the students will be able to:

CO1: Create structured and media-rich web pages using HTML elements, forms, tables, and canvas.

CO2: Apply CSS styling principles to format web content using various selectors, box models, and layout techniques.

CO3: Develop dynamic web content through JavaScript programming, DOM manipulation, and event handling.

CO4: Design server-based applications using PHP and effectively manage data with XML and JSON formats.

Unit I

Introduction to Internet, WWW, Web Browsers, and Web Servers, URLs, MIME, HTTP, Security. Fundamentals of HTML: Understanding the Elements, Describing the datatypes, working with text, Organizing text in HTML, working with links & URLs, Creating tables, Working with Images, Colors, and Canvas, Working with forms.

Unit II

Overview of CSS, Background color and gradient, Cascading Style Sheet: Introduction, Levels of Style Sheet and specification formats, embedded style sheet, External Style Sheet, inline Style Sheet, Box Model, selector forms, Class and ID method, DIV and SPAN tags, Inheritance with CSS.

Unit III

Overview of JavaScript, JavaScript functions, Language Basics – Variables, operators, statements, functions, Data type conversions, reference types, Document object Model: methods, HTML DOM Elements, changing HTML and CSS, Events and event handling, event listener, form validation. Browser Object Model: Window, screen, history, popup alert, timing, cookies, Image maps.

Unit IV

Web Database programming using PHP, Storing and extracting XML Documents from Database, Introduction to JSON Framework, Introduction to JSON: Syntax, Data Types, Schema, Uses, Examples, Difference between JSON and JavaScript.

Textbooks:

1. HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) – DT Editorial Services, 2nd Edition – 2016, Dreamtech Press.
2. Internet and World Wide Web: How to Program - Paul Deitel, Harvey Deitel, Abbey Deitel, 5th Edition - 2018, Pearson Education.
3. Fundaments of Database Systems- Elmasri, Navathe, 7th Edition 2016, Pearson Education.

References:

1. HTML & CSS: The Complete Reference - Thomas Powell, 5th Edition – 2015, McGrawHill Education.
2. Introduction to JavaScript Object Notation by Lindsay Bassett Released August 2015 Publisher(s): O'Reilly Media, Inc. ISBN: 9781491929483.

Web link References:

1. When E-learning Meets Web 3.0: Applications and Challenges
   Link- https://ieeexplore.ieee.org/document/10107827
   Published in: 2023 IEEE 12th International Conference on Educational and Information Technology (ICEIT)
2. Web Mining: Opportunities, Challenges, and Future Directions
   Link- https://ieeexplore.ieee.org/document/10205913
   Published in: 2023 3rd International Conference on Intelligent Technologies (CONIT)
3. Social Media Login Authentication with Unity and Web Sockets
   Link- https://ieeexplore.ieee.org/document/10346940
   Published in: 2023 International Conference on Computer Science and Emerging Technologies (CSET)
4. https://www.json.org/json-en.html

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	2	2	1	1	2	2	1
CO2	3	3	2	2	3	1	1	2	2	1
CO3	3	3	3	3	3	1	1	2	3	2
CO4	3	3	3	3	3	2	1	2	3	2
Weighted Average	3	2.75	2.25	2.5	2.75	1.25	1	2	2.5	1.5

Practicals:

Students are required to design and develop interactive, secure, and data-driven web applications using a range of web technologies and frameworks.

1. Creating a Simple Web Page using basic HTML elements (headings, paragraphs, formatting tags).
2. Working with Hyperlinks and Navigation — <a> tags, internal and external links, image links.
3. Creating and Formatting Tables in HTML with rowspan, colspan, and captions.
4. Inserting and Formatting Images, Colors, and Canvas — image formats, alt text, drawing on canvas.
5. Designing and Handling Forms — text fields, checkboxes, radio buttons, dropdowns, file uploads, and submit/reset buttons.
6. Applying Inline, Internal, and External CSS to an HTML page.
7. Using CSS Selectors and Pseudo-classes for styling specific elements.
8. Implementing the Box Model — margins, borders, padding, and content.
9. Working with Colors and Gradients for backgrounds and text.
10. Positioning Elements and Layouts using DIV, SPAN, flexbox, and grid.
11. Basic JavaScript Programs — variables, operators, loops, and functions.
12. Manipulating HTML & CSS via DOM — getElementById, querySelector, changing styles
    dynamically.
13. Event Handling — onclick, onmouseover, and using addEventListener().
14. Form Validation — validating email, password, and number fields.
15. Using Browser Object Model (BOM) — alerts, confirm, prompt, timers, and cookies.
16. Introduction to PHP — creating a basic PHP script and displaying output on the browser.
17. Web Form Handling with PHP — retrieving form data using GET and POST.
18. Storing and Retrieving XML Data — parsing XML documents in PHP.
19. Working with JSON in JavaScript — parsing and stringifying JSON data.
20. Comparing JSON and JavaScript Objects with examples.

Mini Project

End-to-End Web Application — design and develop a complete website integrating:

- HTML for structure
- CSS for styling
- JavaScript for interactivity & form validation
- PHP for server-side processing
- XML/JSON for data storage and exchange

HC DISSERTATION WORK 0:2:10

Objectives:

- To offer students a glimpse into real-world problems and help them to learn how to apply the tools and techniques they have learned in their respective courses.
- To provide students with practical industry experience through internships, allowing them to understand the dynamics of a professional work environment.
- To help students develop openness to new ideas in computer science and create precise specifications for the execution of their project ideas.
- To promote the development of team-working skills, problem-solving abilities, and effective presentation skills among students, both in their projects and internships.

Course outcomes:

At the end of the course the students will be able to:

CO1: Understand emerging trends in new technologies by conducting surveys of various literatures in the preferred field of study, and by gaining exposure to industry practices through internships.

CO2: Develop real-time projects by comparing several existing solutions for a research challenge and applying the skills learned during the Project Work /internship.

CO3: Demonstrate the ability to work in teams, manage the process of building the project within the stipulated time and also integrate feedback from industry mentors.

CO4: Report and present the findings of the research study/ Project and the internship experience, highlighting the application of learned tools and techniques.

Students are required to implement various kinds of problems using Java-based frameworks, Python, PHP, MySQL, cloud tools, IoT tools, Dot NET, CASE tools, open-source tools, mobile application-oriented tools, and data mining/machine learning tools and techniques.

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	2	1	2	1	2	2	3
CO2	3	3	3	2	2	1	1	2	3	2
CO3	2	3	3	2	2	2	1	3	3	2
CO4	2	2	3	2	2	2	2	3	3	2
Weighted Average	2.5	2.5	2.5	2	1.75	1.75	1.5	2.5	2.75	2.25

SC ARTIFICIAL INTELLIGENCE 3:1:0

Total: 45 hours

Objectives:

- To introduce fundamental AI concepts, problems, and historical developments.
- To compare and contrast different AI techniques.
- To understand the concepts of knowledge Representation.
- To explore AI in computer vision (face recognition, Eigenfaces).

Course Outcomes:

At the end of the course the students will be able to:

CO1: Analyze the foundations of AI, including agent rationality and environment interactions.

CO2: Illustrate Search Strategies with algorithms and Problems.

CO3: Implement Proportional logic and apply inference rules.

CO4: Develop game-playing strategies and understand neural networks.

UNIT I: INTRODUCTION

AI problems, Foundation of AI and history of AI intelligent agents: Agents and Environments, The concept of rationality, The nature of environments, Structure of agents, Problem solving agents, Problem formulation, Applications of AI (Healthcare, Finance, Robotics, NLP, etc.), AI Ethics, Bias, and Societal Impact.

UNIT II: LOCAL SEARCH ALGORITHM

Searching: Uninformed search strategies – Breadth first search, depth first search. Generate and Test, Hill climbing, simulated annealing search, Constraint satisfaction problems, Greedy best first search, A* search, AO* search.

UNIT III: KNOWLEDGE REPRESENTATION

Propositional logic - syntax & semantics - First order logic. Inference in first order logic, propositional Vs. first order inference, unification & lifts, Clausal form conversion, Forward chaining, Backward chaining, Resolution.

UNIT IV: GAME PLAYING, PLANNING AND NEURAL NETWORKS

Overview, Minimax algorithm, Alpha-Beta pruning, How Machines "See" Images, Pixels, channels (RGB), and tensors, Neural Networks for Images: Convolutional Neural Networks (CNNs), Filters, pooling, and feature maps, Real-World Applications: Face Recognition (Eigenfaces, modern deep learning).

References:

1. Artificial Intelligence, E. Rich and K. Knight, 3rd Edition, TMH.
2. Artificial Intelligence A Modern Approach, S. Russell and P. Norvig, 3rdEdition, Pearson Education.

3. Introduction to Artificial Intelligence, Eugene Charniak and Drew McDermott, 2ndEdition, Pearson Education.
4. Brachman, R. and Levesque, H., Knowledge Representation and Reasoning, 1st Edition, Morgan Kaufmann.
5. Rosebrock, A., Deep Learning for Computer Vision with Python, 1st Edition, PyImageSearch.

Weblink References:

1. https://bioimagebook.github.io/chapters/1-concepts/4-colors/colors.html
2. https://arxiv.org/pdf/1811.00116
3. https://arxiv.org/pdf/1511.08458
4. https://plato.stanford.edu/entries/artificial-intelligence/#InteAgenCont.
5. https://www.redblobgames.com/pathfinding/a-star/introduction.html.
6. https://developers.google.com/machine-learning/practica/image-classification.
7. https://www.youtube.com/playlist?list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi.

Course Articulation Matrix:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3	3	3	3	3	3	2	2	2	3
CO2	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	2	2	2	3
CO4	3	3	3	3	3	3	2	2	3	3
Weighted Average	3	3	3	3	3	3	2.25	2	2.5	3

SC DATABASE SYSTEMS 3:0:1

Total: 60 hours

Objectives:

- Gain an in-depth understanding of the relational data model concepts, constraints, and SQL for database manipulation and management.
- To gain knowledge of functional dependencies and normalization in database design.
- To provide students with an understanding of recovery concepts and techniques that ensure database consistency, reliability, and fault tolerance in the event of system crashes or failures.
- To gain knowledge of database security concepts, access control mechanisms, and privacy preservation.

Course outcomes:

At the end of the course the students will be able to:

CO1: Demonstrate the relational schemas and perform data definition, manipulation, and querying using SQL.

CO2: To implement and utilize normalization for efficient schema design.

CO3: To analyze and apply recovery mechanisms such as deferred update, immediate update, shadow paging, ARIES, and backup strategies to maintain data integrity in single and multidatabase systems.

CO4: To implement and utilize security techniques to protect databases and ensure data privacy.

Unit I: The Relational Data Model and SQL The Relational Data Model and Relational Database Constraints, Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations. Basic SQL, SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL, Additional Features of SQL.

Unit II: Database Design Theory and Normalization Basics of Functional Dependencies and Normalization for Relational Databases, Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multi valued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Unit III: Database Recovery Techniques, Recovery Concepts, NO-UNDO/REDO Recovery Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, The ARIES Recovery Algorithm, Recovery in Multidatabase Systems, Database Backup and Recovery from Catastrophic Failures.

Unit IV: Database Security Database Security, Introduction to Database Security Issues, Discretionary Access Control Based on Granting and Revoking Privileges, Mandatory Access Control and Role-Based Access Control for Multilevel Security, Introduction to Statistical Database Security, Introduction to Flow Control, Encryption and Public Key Infrastructures, Privacy Issues and Preservation, Challenges to Maintaining Database Security.

Textbook:

1. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, 7e.

References:

1. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw- Hill Education, 7e.
2. Principles of Database and Knowledge-Base Systems, Jeffrey D. Ullman. 3. DBMS, Prof. S. Nandagopalan, S. Chand Publishing, 7e.

Web link References:

1. SQL and NoSQL Database Software Architecture Performance Analysis and Assessments—A Systematic Literature Review, Wisal Khan, Teerath Kumar, Cheng Zhang, Kislay Raj, Arunabha M. Roy, Bin Luo.
   https:// www.mdpi.com/2504-2289/7/2/97.
2. Advancing database security: a comprehensive systematic mapping study of potential challenges, Asif Iqbal, Siffat Ullah Khan, Mahmood Niazi, Mamoona Humayun, Najm Us Sama, Arif Ali Khan, Aakash Ahmad.
   https:// link.springer.com/content/pdf/10.1007/s11276-023-03436-z.pdf

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	2	1	1	1	2	3
CO2	3	2	3	2	2	1	1	-	3	2
CO3	2	3	3	2	3	2	1	2	2	3
CO4	3	2	2	2	2	3	1	1	3	2
Weighted Average	2.75	2.25	2.75	2	2.25	1.75	1	1.33	2.5	2.5

Practicals:

Students are required to understand, design, and implement relational, NoSQL, apply normalization techniques, and ensure database security.

1. Schema Creation: Create a database with constraints (PRIMARY KEY, FOREIGN KEY, UNIQUE, CHECK).

2. Data Manipulation: Use INSERT, UPDATE, DELETE, SELECT with filtering, ordering, and aggregation.
3. Transactions: Demonstrate COMMIT, ROLLBACK, and constraint violation handling.
4. Joins & Nested Queries: INNER JOIN, LEFT JOIN, correlated subqueries.
5. Identify Functional Dependencies from a dataset.
6. Convert an unnormalized schema to 1NF → 2NF → 3NF → BCNF.
7. Implement the normalized schema in SQL and verify with sample queries.
8. Write a SQL program that inserts records into a table, deliberately force an error (like divide by zero), and check if changes are rolled back.
9. Create two copies of a table (original and shadow). Perform updates only on shadow copy and later switch pointers.
10. Create users with different privileges (GRANT, REVOKE) on tables and test access.
11. Define roles (e.g., Admin, Faculty, Student), assign privileges to roles, and map users to roles.
12. Create classification levels (e.g., Confidential, Secret, Public) and restrict access using views.
13. Demonstrate query restrictions (e.g., students cannot query counts if group size < 3, to prevent inference).

SC CLOUD SECURITY AND PRIVACY 4:0:0

Total: 45 hours

Objectives:

- Understand the foundational concepts and models of cloud computing.
- Gain knowledge of the various aspects of data security in the cloud, including mitigation strategies, access control, and incident response.
- Explore privacy concerns related to cloud computing.
- Examine advanced security solutions available as services in the cloud.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Explain the evolution, key definitions, SPI service models (SaaS, PaaS, IaaS), deployment models, primary drivers, and adoption barriers of cloud computing.

CO2: Apply principles of data security, availability, access control, intrusion detection, and understand the shared responsibility model between customers and Cloud Service Providers (CSPs).

CO3: Evaluate data privacy concerns, the full data life cycle, compliance requirements, and compare key cloud providers (AWS, Google, Azure), including private cloud platforms like OpenStack.

CO4: Assess cloud-based security services (SECaaS), evaluate email/web content filtering, identify emerging threats in CSP usage, and explore future cloud security trends such as Zero Trust, AI/ML defenses, and confidential computing.

UNIT I

The Evolution of Cloud Computing, Cloud Computing defined, SPI framework for cloud computing, The Cloud Services Delivery Model, Cloud Deployment Models, Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise.

UNIT II

Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security, Security Management in the Cloud, Availability Management- SaaS, IaaS, PaaS, Access Control, Intrusion Detection and Incident Response, Customer Versus CSP Responsibilities.

UNIT III

Privacy, What Is the Data Life Cycle?, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Examples of Cloud Service Providers, Amazon Web Services (IaaS), Google (SaaS, PaaS), Microsoft Azure Services Platform (PaaS), Sun Open Cloud Platform, Approaches to an Open stack Private Cloud.

UNIT IV

Security-As-a-[Cloud] Service, Email Filtering, Web Content Filtering, The Impact of Cloud Computing on the Role of Corporate IT, Why Cloud Computing Will Be Popular with Business Units, Potential Threats of Using CSPs, The Future of Security in Cloud Computing.

References:

1. Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly Media.
2. Cloud Computing: Principles and Paradigms – Rajkumar Buyya, James Broberg,Andrzej M Goscinski, Wiley publication.
3. Cloud Computing: A Practical Approach – Toby Velte, Anthony Velte, McGraw-Hill Osborne Media.
4. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud – George Reese, O'Reilly Publication.
5. Cloud Computing Explained: Implementation Handbook for Enterprises – John Rhoton, Recursive Press.
6. OpenStack: The Path to Cloud, Considerations and recommendations for businesses adopting cloud technology, openstack.org

Web link References:

1. Security and Privacy in Cloud Computing: Technical Review by Yunusa Simpa Abdulsalam and Mustapha Hedabou. https://www.mdpi.com/1999-5903/14/1/11
2. A Survey on Cloud Security Issues and Techniques, Garima Gupta, P.R.Laxmi and Shubhanjali Sharma. https://arxiv.org/pdf/1403.5627

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	1	2	2	1	1	1	1
CO2	2	3	3	2	2	2	2	2	2	2
CO3	2	2	3	2	2	2	2	2	2	2
CO4	2	3	3	3	2	2	2	2	2	2
Weighted Average	2	2.5	2.75	2	2	2	1.75	1.75	1.75	1.75

SC NETWORK SECURITY 3:1:0

Total: 45 hours

Objectives:

- To introduce fundamental concepts of computer security, including types of attacks, services, and mechanisms.
- To provide an understanding of classical encryption methods and foundational symmetric key cryptography.
- To explain the principles of public-key cryptography and the role of cryptographic hash functions in secure communications.
- To explore the security risks and protective measures in cloud computing and web-based communication.

Course outcomes:

At the end of the course the students will be able to:

CO1: Students will be able to identify and differentiate between various security attacks and explain key security services and mechanisms.

CO2: Students will be able to apply substitution and transposition techniques, understand the DES algorithm, and evaluate its strengths and limitations.

CO3: Students will be able to implement and Analyze public-key algorithms such as RSA and Diffie-Hellman, and understand their cryptographic applications.

CO4: Students will be able to identify cloud security risks, apply data protection strategies, and understand secure communication protocols like TLS and HTTPS.

Unit I

Introduction: Computer Security Concepts-Definition, Examples, Challenges, Security Attacks- Passive Attacks, Active Attacks, Security Services- Authentication, Access Control, Data Confidentiality, Data Integrity, Nonrepudiation, Availability Service, Security Mechanisms.

Unit II

Classical Encryption Techniques-Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography. The DES, The strength of DES, Block Cipher Design Principles.

Unit III

Principles of Public-key cryptosystems, RSA, Diffie Hellman key exchange, Applications of Cryptographic Hash Functions, Two simple Hash Functions.

Unit IV

Cloud Computing, Cloud Security Risks and counter measures, Data Protection in the cloud, Web security Considerations, Transport Layer Security, HTTPS.

Textbook:

1. Cryptography and Network Security-Principles and Practice, William Stallings, PEARSON, 7e.

Reference:

1. Cryptography and Network Security, Atul Kahate, Tata McGraw Hill.

Weblink References:

1. Yu Zhang, et.al., "A Survey of Secure Communications for Satellite Internet Based on Cryptography and Physical Layer Security". https://www.hindawi.com/journals/ietis/2023/5604802/
2. V. Esther Jyothi, et.al., "Analysis of Cryptography Encryption for Network Security" https://iopscience.iop.org/article/10.1088/1757-899X/981/2/022028/meta
3. Akanksha Arora, et.al.,"Privacy Protection of Digital Images Using Watermarking and QR Code-based Visual Cryptography" https://www.hindawi.com/journals/am/2023/6945340/

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	3	2	3	3	2	2	2
CO2	3	3	3	3	2	2	2	2	2	2
CO3	3	3	3	3	3	2	2	2	2	3
CO4	3	3	3	3	3	3	3	2	2	3
Weighted Average	2.75	2.75	3	3	2.5	2.5	2.5	2	2	2.5

SC BIG DATA ANALYTICS 3:0:1

Total: 60 hours

Objectives:

- To gain knowledge of Hadoop architecture and MapReduce programming for Big Data processing.
- To explore MongoDB architecture, commands, and techniques for managing NoSQL data.
- To understand different data types and statistical methods for data analysis.
- To learn the fundamentals of R programming and its data analysis capabilities.

Course Outcomes:

At the end of the course the students will be able to:

CO1: To demonstrate and implement data processing using HDFS, YARN, and MapReduce components.

CO2: To utilize MongoDB for performing data operations, indexing, and aggregation effectively.

CO3: To apply statistical techniques like correlation, regression, and ANOVA for data interpretation.

CO4: To implement data handling and exploratory analysis using R's data structures, libraries, and graphics.

Unit I: Introduction to Hadoop and MAPREDUCE Programming

Getting an overview of Big Data, Introducing Hadoop, Why Hadoop? Why not RDBMS? RDBMS versus Hadoop, HDFS (Hadoop Distributed File System), Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet Another Resource Negotiator), Interacting with Hadoop Ecosystem.

Introduction to MAPREDUCE Programming: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression

Unit II: Introduction to Mongo DB

Introduction to MongoDB, Terms Used in RDBMS and MongoDB, Managing and administering Mongodb – Mongodb administering commands and methods, drop Db command, Mongodb query, Write operation command and methods, Data Types in MongoDB, Mongodb CRUD operation, Create index and index types, Introduction to Mongodb aggregation and Sharding.

Unit III: Statistical Analysis of data

Types of data for statistical analysis, Basic statistical measures, nominal distribution, Correlation analysis, Regression analysis, ANOVA

Unit IV: Introduction to R

Introduction to R- Data types of R, Data structures of R, Libraries in R, Graphics using R – Exploratory data analysis.

References:

1. Big Data and Analytics, 2ed, Seema Acharya, Subhashini Chellappan, Wiley.
2. Mongodb complete Guide, Manu Sharma, BPB Publications.
3. R programming An approach to Data Analytics, Dr. G. Sudhmathy & Dr. C. Jothi Venkateswaran, MJP publishers.
4. Big Data Analytics, M. Vijayalakshmi, Radha Shankarmani, Wiley

Weblink References:

1. A Distributed Framework for Predictive Analytics Using Big Data and MapReduce Parallel Programming, P. Natesan, 1 V. E. Sathishkumar, 2 Sandeep Kumar Mathivanan, HindawiMathematical Problems in EngineeringVolume 2023,Article ID 6048891, 10 pages, https:// onlinelibrary.wiley.com/doi/epdf/10.1155/2023/6048891
2. Optimal Management of Computer Network Security in the Era of Big Data, Hindawi Journal of Computer Networks and Communications Volume 2022, Article ID 9049420, 10 page https:// onlinelibrary.wiley.com/doi/epdf/10.1155/2022/9049420
3. Research Article on Rating Batters in Test Cricket, Hindawi Mathematical
4. Problems in Engineering Volume 2022, Article ID 9215635, 10 page, https: //onlinelibrary.wiley.com/doi/epdf/10.1155/2022/9215635

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	2	2	2	2	2
CO2	3	3	3	2	3	2	2	2	2	2
CO3	2	3	3	3	3	2	2	2	2	3
CO4	3	3	3	3	3	2	2	2	3	3
Weighted Average	2.75	3	3	2.5	3	2	2	2	2.25	2.5

Practicals:

1. Install and configure a single-node Hadoop cluster.
2. Store and retrieve files from HDFS.
3. Implement a basic MapReduce program (Word Count).
4. Implement MapReduce for sorting and filtering data.
5. Implement MapReduce for statistical computations (mean, max, min).
6. Install and configure MongoDB.
7. Perform CRUD operations on MongoDB collections.
8. Create and use indexes to improve query performance.
9. Use MongoDB aggregation pipeline for analytics.
10. Demonstrate sharding in MongoDB.
11. Perform correlation and regression analysis on a dataset (using R).

12. Conduct ANOVA test on sample data.
13. Import and clean datasets in R.
14. Perform exploratory data analysis (EDA) with summary statistics and plots.
15. Create visualizations in R (histograms, scatter plots, boxplots).

SC THEORY OF LANGUAGES 3:1:0

Total: 45 hours

Objectives:

- Understand the formal proof techniques and foundational concepts in automata theory.
- Develop the ability to work with regular expressions and understand properties of regular languages.
- Explore context-free grammars, their applications, and pushdown automata.
- Understand the properties of context-free languages and basic concepts of Turing machines.

Course outcomes:

At the end of the course the students will be able to:

CO1: Construct and analyze deterministic and non-deterministic finite automata, including epsilon transitions.

CO2: Convert between regular expressions and automata, and apply pumping lemma and DFA minimization techniques.

CO3: Generate and analyze context-free languages using CFGs and equivalent pushdown automata.

CO4: apply pumping lemma for CFLs, explore closure properties, and describe Turing machine configurations and Post's Correspondence Problem

Unit I

Brief introduction to Formal Proof: Deductive Proofs, Poving equivalences about sets, the contra positive, Proof by contradiction, Counterexamples, Central concepts of automata theory: Alphabets, strings, languages.

Finite Automata: Deterministic Finite Automata, Nondeterministic Finite Automata, Equivalence of DFA and NFA, Finite Automata with Epsilon transitions.

Unit II

Regular Expressions, Finite Automata and Regular Expressions: Converting DFAs to regular expressions by eliminating states, converting regular expressions to automata, Applications of regular expressions, Brief overview of algebraic laws of regular expressions.

Properties of Regular Languages: The pumping lemma for regular languages, Applications of the pumping lemma, Closure properties and decision properties of regular languages (proofs not necessary), Minimization of DFAs.

Unit III

Context-Free Grammars, Parse Trees, Applications of context-free grammars, Ambiguity in grammars and languages. Normal Forms for Context-free grammars.

Pushdown Automata: Definition, Languages of a PDA, Equivalence of PDAs and CFGs, Deterministic Pushdown Automata.

Unit IV

The pumping lemma for context-free languages, Closure properties of context-free languages (proofs not necessary).

Brief introduction to Turing Machine: Notation for Turing Machine, Instantaneous descriptions for Turing Machines, Transition Diagrams for Turing Machine.

Definition of Post's Correspondence Problem.

Textbook:

1. Introduction to Automata Theory, Languages and Computation, Hopcroft J. E and lman, J.D, Narosa Publishing House, 3e.

References:

1. Introduction to Languages and Theory of Computation, John C Martin, TMH Publication, 3e.
2. Elements of Automata Theory, Peter J. Cameron, Cambridge University Press, 2e.

Web link References:

1. Simulation of Turing Machine, Ajinkya Ghusarkar, Girish Nikam, Atharva Thokal, Sourabh Shintre, https://www.irjet.net/archives/V10/i1/IRJET-V10I149.pdf.
2. Turing Machine and the Conceptual Problems of Computational Theory, Edward E. Ogheneovo, https://www.researchinventy.com/papers/v4i4/G044053060.pdf.

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	1	1	1	1	2	2
CO2	2	3	3	3	1	1	1	1	1	2
CO3	2	3	3	3	1	1	1	1	1	2
CO4	2	3	3	3	1	1	1	1	1	2
Weighted Average	2	3	3	3	1	1	1	1	1.25	2

SC PROBABILITY AND STATISTICS 3:1:0

Total: 45 hours

Objectives:

- Apply the basic principles of probability and discrete distributions to model uncertain events.
- Evaluate joint distributions, expectations, and relationships between random variables.
- Utilize continuous probability distributions to analyze real-world random phenomena.
- Understand the sampling techniques and statistical inference methods to draw conclusions from data.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Compute probabilities using rules, theorems, and discrete distributions like Binomial and Poisson.

CO2: Calculate expected values, variances, and correlations for functions of random variables.

CO3: Analyse and work with exponential, normal, and chi-square distributions for data analysis.

CO4: Perform hypothesis tests, estimate parameters, and evaluate model fit using regression and chi-square tests.

Unit I

Probability: The concept of probability, the axioms and theorems, conditional probability, Independent Event's, Bayes Theorem. Random Variables and Probability Distributions: Random variables, discrete probability distributions and Distribution functions: Bernoulli, Binomial, Hyper Geometric, Geometric, Poisson, Uniform.

Unit II

T joint Distributions, Independent random variables, Functions of random Variables. Mathematical Expectation: Definition, Functions of Random variables. The variance and Standard Deviation, Moments, Moment Generating Functions, Covariance, Correlation Coefficient.

Unit III

Continuous Probability distribution and Distributions functions: Exponential, Normal, Uniform, Concepts of Chi square.

Unit IV

Sampling Theory & Estimation: Population and sample, Random Sampling with and without replacement, the sample mean, sampling distribution of means, proportions,

differences. The sample variance, the sample distribution of variances, Point estimates, Interval estimates. Variance analysis. Tests of Hypotheses and Significance: Statistical Decisions, Statistical hypotheses, Null Hypotheses, Tests of hypotheses and significance, Type I and Type II errors, level of significance, Tests involving the Normal distribution, One-Tailed and Two-tailed, Special tests of Significance for large and small samples, The Chi-square test for goodness off it. Introduction to regression and curve fitting.

Textbooks:

1. Fundamentals of Statistics-SC Gupta and VK Kapoor, S Chand and sons.
2. Probability and Statistics with Reliability, Queuing and Computer Applications – JusgirS Trivedi, Prentice Hall of India.
3. Probability, Random Variables and Stochastic Processes – PapoulisandS. Unnikrishna Pillai, Mc Graw Hill,4th Edition.
4. Probability and Statistics for Engineers-Richard A Johnson, Prentice Hall India.

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	2	3	1	1	1	2	2
CO2	2	3	3	3	3	-	1	1	2	2
CO3	2	3	3	3	3	1	1	1	1	2
CO4	2	3	3	3	3	-	1	1	2	2
Weighted Average	2	3	3	2.75	3	1	1	1	1.75	2

SC INTERNET OF THINGS 3:1:0

Total: 45 hours

Objectives:

- Understand the concept of the Internet of Things (IoT) and its role in connecting everyday objects to the internet.
- Explore IoT architectures, including sensors, actuators, communication protocols, and cloud computing.
- Learn about IoT applications across various industries, such as smart homes, healthcare, agriculture, and industrial automation.
- Recognize the challenges and future trends in IoT, such as interoperability,
- scalability, and edge computing.

Course outcomes:

At the end of the course the students will be able to:

CO1: Explain the fundamental concepts, architecture, and enabling technologies of the Internet of Things (IoT).

CO2: Describe the role of smart objects, sensors, actuators, and different IoT levels in building intelligent IoT systems.

CO3: Apply IoT platform design methodology to systematically specify, model, and develop IoT applications from requirements to deployment.

CO4: Analyze domain-specific IoT applications in environmental monitoring and health & lifestyle, highlighting their design and implementation challenges.

Unit I

Introduction to IoT: Definition and Characteristics, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies – Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems.

Unit II

Smart Objects &IoT Levels – Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.

Unit III

IoT Platforms Design Methodology- Introduction, IoT Design Methodology, Step 1: Purpose & Requirements Specification, Step 2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specifications, Step 6: IoT Level Specification, Step 7: Functional View Specification, Step 8: Operational View Specification, Step 9: Device & Component Integration, Step 10: Application Development.

Unit IV

Domain Specific IoTs: Environment- Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection. Health & Lifestyle- Health & Fitness Monitoring, Wearable Electronics.

Textbooks:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-on Approach,2015,1st Edition, Universities Press.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things–Key applications and Protocols,2012, Wiley Publication.
3. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective,2012, CRC Press.

References:

1. Dieter Uckelmann; Mark Harrison; Florian Michahelles Architecting the Internet of Things,2011, Springer.
2. Internet of Things: Architecture and Design Principles-Raj Kamal,1stEdition, McGraw Hill Education

Weblink References:

1. Yinghua Shen, et.al., "Exploring the Structure of IoT Data: A Symbolic Analysis Perspective" https://www.hindawi.com/journals/wcmc/2023/3267820/
2. Muruga perumal Krishnamoorthy, et.al., "A Design and Development of the Smart Forest Alert Monitoring System Using IoT" https:// www.hindawi.com/journals/js/2023/8063524/
3. Angeliki Boltsi , et.al., "Digital Tools, Technologies, and Learning Methodologies for Education4.0 Frameworks: A STEM Oriented Survey" https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10401932

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	1	2	1	1	1	1	2
CO2	3	2	3	1	3	1	1	1	2	2
CO3	3	3	3	2	3	2	2	1	3	2
CO4	3	3	3	3	3	2	2	1	3	3
Weighted Average	3	2.5	2.75	1.75	2.75	1.5	1.5	1	2.25	2.25

SC MOBILE APPLICATION DEVELOPMENT WITH ANDROID 3:0:1

Total: 60 hours

Objectives:

- Understand the fundamentals of Android development and how to create basic applications using core Android tools.
- Comprehend the structure of Android applications, including key components like activities, services, intents, and permissions.
- Learn to design interactive and user-friendly interfaces using various layout managers and UI elements in Android.
- Explore Android APIs for data management, networking, and web integration to build connected applications.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Develop simple Android applications demonstrating the use of basic Android components and tools..

CO2: Design and build well-structured Android apps incorporating activities, intents, and user interface layouts.

CO3: Implement data sharing and communication between Android apps using SQLite, content providers, and networking APIs.

CO4: Prepare and deploy Android applications to the Google Play Store following standard publishing practices.

Unit I: Introduction to Android

History of Mobile Software Development, Open Handset Alliance, Android Platform Android SDK, Building a sample Android application, Anatomy of Android applications, Android terminologies.

Unit II: Android Application Design Essentials

Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions, Managing Application resources in a hierarchy, Working with different types of resources.

Unit III: Android User Interface Design Essentials

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

Unit IV: Using Android APIs

Brief Introduction on these: Using Android Data and Storage APIs, Managing data using SQLite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying (selling) your Android application.

Textbook:

1. Crawl Walk Run Advancing Analytics Maturity with Google Marketing Platform, Michael Loban Alex Yastrebenetsky, Edition II: Revised and Expanded with Google Analytics 4 and ADS Data Hub

References:

1. "Android Wireless Application Development", Lauren Darcey and Shane Conder, 2nd edition, Pearson Education.
2. "Professional Android2 Application Development", RetoMeier, Wiley India.
3. "Beginning Android", Mark Murphy, Wiley India.
4. "Pro Android", Sayed Y Hashimi and Satya Komatineni, Wiley India.

Weblink References:

1. Facial Emotion Recognition for Mobile Devices: A Practical Review
   Link- https://ieeexplore.ieee.org/document/10414102
   Published in: IEEE Access (Volume: 12) (2023)
2. Protecting Android Devices From Malware Attacks: A State-of-the-Art Report of Concepts, Modern Learning Models and Challenges
   Link-https://ieeexplore.ieee.org/document/10274970 Published in: IEEE Access (Volume: 11) (2023)
3. Job and Internship Assistance Application
   Link- https://ieeexplore.ieee.org/document/10150490
   Published in: 2023 International Conference on Disruptive Technologies (ICDT)
4. Food Wastage Management Application using Android Studio
   Link- https://ieeexplore.ieee.org/document/10140489
   Published in: 2023 2nd International Conference on Applied Artificial Intelligence and Computing (ICAAIC)
5. Android Dashboard App Development for Autonomous Vehicles Using Fire Base
   Link- https://ieeexplore.ieee.org/document/10333326
   Published in: 2023 7th International Conference on Computation System and Information Technology for Sustainable Solutions (CSITSS)

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	3	2	2	1	1	2	2
CO2	3	3	3	3	3	2	1	2	2	2
CO3	3	3	3	3	2	3	1	2	3	3
CO4	3	3	3	3	3	2	1	2	3	3
Weighted Average	3	3	2.75	3	2.50	2.25	1	1.75	2.5	2.5

Practicals:

Students are required to design, develop, and deploy mobile applications using the Android platform.

1. Android Development Environment – Setting up SDK, building a sample application, and understanding Android terminologies.
2. Application Components – Application context, activities, services, intents, broadcast receivers, and intent filters.
3. Manifest File & Permissions – Structure, common settings, and security permissions in Android.
4. Resource Management – Organizing resources hierarchically and working with various resource types.
5. User Interface Components – Screen elements, widgets, and UI interaction basics.
6. Layout Design – Designing user interfaces with different layouts for multiple screen sizes.
7. Graphics & Animation – Drawing on the canvas, working with animation APIs, and visual effects.
8. Data & Storage APIs – Using internal/external storage and managing data with SQLite.
9. Content Providers – Sharing data between applications securely.
10. Networking & Web APIs – Accessing network services and integrating with web-based APIs.
11. Telephony APIs – Implementing phone call, SMS, and related functionalities.

SC DATA INDEXING TECHNIQUES 3:0:1

Total: 60 hours

Objectives:

- Learn the basics of data indexing and why it is important for efficient data Retrieval using ADT.
- Explore different types of data indexing techniques, such as B-trees and hash indexing.
- Understand how to choose the right indexing technique based on the type of data structures binary tree, AVL tree.
- Study the impact of indexing using hashing.

Course outcomes:

At the end of the course the students will be able to:

CO1: Implement and analyze linear data structures such as arrays, linked lists, vectors, lists using STL and utilize iterators for efficient data traversal.

CO2: Understand and apply heap-based priority queues including binary heaps and perform core operations to solve scheduling and resource management problems.

CO3: Implement various binary tree structures including binary search trees, AVL trees, B+ trees and apply tree-based algorithms to real-world hierarchical data.

CO4: Apply various hashing techniques and collision resolution strategies to implement efficient hash-based data retrieval systems.

Unit I

Abstract Data type, List ADT: simple array implementation and simple linked list implementation, Vector and list in STL, Iterators, Implementation of vector, Implementation of list.

Unit II

Priority queue (Heap): Simple Implementation, Binary Heap, Structure property, Heap order property, Basic heap operations, Application of priority queue.

Unit III

Review on Binary tree: Implementation and example of expression tree; Binary Search tree: insertion and deletion operations, AVL tree: single rotation and double rotation, B+ tree.

Unit IV

Hashing, Hash Function, Static hashing: Division method, multiplication method, multiply shift method, Random hashing: Linear Probing, Double Hashing, Rehashing, Applications.

Textbooks:

1. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. and Clifford Stein.
2. "Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss.

Reference:

1. "Algorithms in C++" by Robert Sedgewick.

Weblink References:

1. https://www.prepbytes.com/blog/data-structure/abstract-data-type-adt-in-data-structure/#:~:text=List%20ADT,the%20address%20of%20another%20block.
2. https://ebooks.inflibnet.ac.in/csp01/chapter/priority-queue-and-heaps/
3. https://www.scholarhat.com/tutorial/datastructures/hashing-in-data-structures
4. .https://www.appsealing.com/hashing-algorithms/

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	3	-	-	1	2	2
CO2	3	3	2	2	3	-	-	1	2	2
CO3	3	3	3	3	2	-	-	1	2	2
CO4	3	3	3	3	3	-	-	1	2	3
Weighted Average	3	2.75	2.5	2.5	2.75	-	-	1	2	2.25

Practicals:

1. **Array Implementation of List ADT**
   - Perform insert, delete, search operations.
   - Menu-driven implementation.
2. **Linked List Implementation of List ADT**
   - Singly linked list with operations: insertion (beginning, end, middle), deletion, traversal.
3. **STL Vector Implementation**
   - Perform push_back, pop_back, insert, erase, and iterate using iterators.
4. **STL List Implementation**
   - Use std::list to perform operations similar to a doubly linked list.
   - Practice forward and reverse iterators.
5. **Simple Priority Queue using Array**
   - Insert elements with priority.
   - Delete the highest/lowest priority element.
6. **Binary Heap Implementation**
   - Implement min-heap or max-heap.

- Perform insert and delete-min/max operations.

7. Binary Tree Implementation

- Construct and traverse (inorder, preorder, postorder) a binary tree.
- Build and evaluate an expression tree.

8. Binary Search Tree (BST)

- Insert and delete nodes.
- Display the BST using inorder traversal.

9. AVL Tree

- Implement single and double rotations.
- Show tree balance before and after operations.

10. B+ Tree (Optional – higher difficulty)

- Simple insertion implementation.
- Visualize data distribution across internal and leaf nodes.

11. Static Hashing

- Implement division, multiplication, and multiply-shift hash functions.
- Store and retrieve keys using simple hash tables.

12. Collision Resolution Techniques

- Linear probing
- Double hashing

13. Rehashing

- Demonstrate resizing the hash table when load factor increases.

SC INFORMATION RETRIEVAL 3:0:1

Total: 60 hours

Objectives:

- Understand Fundamental Information Retrieval Concepts
- Explore Scoring and Ranking Techniques in Information Retrieval systems.
- Apply Text Classification Techniques.
- Analyze and Implement Clustering Algorithms.

Course outcomes:

At the end of the course the students will be able to:

CO1: Develop and Evaluate Inverted Indexes.
CO2: Implement and Assess Scoring Mechanisms.
CO3: Demonstrate proficiency in text classification.
CO4: Apply Clustering Techniques in information retrieval systems.

Unit I: Boolean retrieval and classical models

An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries; The term vocabulary and postings lists: Document delineation and character sequence decoding, Determining the vocabulary of terms, Faster posting list intersection via skip pointers, Positional postings and phrase queries; Index construction – Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, dynamic indexing, other types of indexes.

Unit II: Computing scores in a complete search system

Efficient scoring and ranking, components of an information retrieval system, vector space scoring and query operator interaction; Information retrieval system evaluation, Standard test collections, Evaluation of unranked and ranked retrieval results, Assessing relevance, A broader perspective: System quality and user utility, Results snippets.

Unit III: Text classification and naive bayes

The text classification problem, Naive bayes text classification, properties of Naïve bayes, feature selection; Support vector machines and machine learning on documents – Support vector machines: The linearly separable case, Issues in the classification of text documents, Machine – learning methods in ad hoc information retrieval; Web search basics – Background and history, Web characteristics, Advertising as the economic model, The search user experience.

Unit IV: Clustering

Flat Clustering - Clustering in IR, Problem statement, Evaluation of Clustering, K-means, Model Based Clustering; Hierarchical clustering- Hierarchical agglomerative clustering, Single link, complete link and group average

agglomerative clustering, Centroid clustering, Divisive clustering, cluster labelling.

Textbook:

1. Introduction to information Retrieval, Christopher D.Manning, Prabhakar Raghavan, Hinrich Schutze, Cambridge University Press,1e.

References:

1. Information Retrieval: Algorithms and Heuristics, David A. Grossman and Ophir Frieder, , Springer, 2e.
2. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Pearson,2e.

Web link References:

1. Query expansion techniques for information retrieval: A survey, Hiteshwar Kumar Azad, Akshay Deepak, https://www.sciencedirect.com/science/article/pii/S0306457318305466
2. A Deep Look into neural ranking models for information retrieval, Jiafeng Guo, Yixing Fan, Liang Pang, Liu Yang, Qingyao AiHamed Zamani, Chen Wu, W. Bruce Croft, Xueqi Cheng, https:/ /www.sciencedirect.com/science/article/pii/S0306457319302390
3. Fuzzy Information Retrieval Based on Continuous Bag-of-Words Model, Dong Qiu, Haihuan Jiang and Shuqiao Chen, https://www.mdpi.com/2073- 8994/12/2/225

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	3	1	1	2	2	1
CO2	3	3	2	2	3	1	1	2	3	1
CO3	3	3	2	3	3	1	1	2	3	1
CO4	3	3	3	2	3	1	1	2	3	1
Weighted Average	3	3	2.25	2.25	3	1	1	2	2.75	1

Practicals:

Students are required to implement and evaluate different information retrieval techniques and systems using suitable programming languages, libraries, and frameworks.

1. Text Pre-processing – Tokenization, stop word removal, case normalization, stemming, and lemmatization.
2. Boolean Retrieval – Implementing inverted indexes, Boolean query processing, and postings list operations.

3. Term Vocabulary and Postings Lists – Vocabulary creation, positional postings, skip pointers, and phrase queries.
4. Index Construction – Blocked sort-based indexing, single-pass in-memory indexing, and dynamic indexing.
5. Distributed Indexing – Methods for large-scale IR systems and handling partitioned indexes.
6. Other Types of Indexes – Specialized indexing structures for different retrieval needs.
7. Scoring and Ranking – Efficient scoring algorithms, vector space scoring, and query operator interaction.
8. Evaluation of IR Systems – Using standard test collections, evaluating ranked/unranked retrieval, and assessing relevance.
9. Naïve Bayes Text Classification – Model implementation, properties, and feature selection.
10. Support Vector Machines – Applying SVMs for text classification and understanding issues in
    document classification.
11. Flat Clustering – Implementing K-means and model-based clustering, and evaluating results.
12. Hierarchical Clustering – Implementing Single link, complete link, average link clustering

SC DIGITAL FORENSICS 3:1:0

Total: 45 hours

Objectives:

- To understand the basics of cyberspace, cyber crimes, and digital financial frauds.
- To explore tools and techniques used in cyber forensics and identify various cyber threats.
- To learn methods and procedures for conducting cyber investigations and profiling cyber criminals.
- To understand and apply methods for collecting, analyzing, and reporting digital evidence in cyber crime cases.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Outline the cyber crime types and to understand jurisdictional and legal challenges.

CO2: Identify and describe digital threats and forensic methods.

CO3: Apply cyber investigation techniques including profiling and log analysis.

CO4: Demonstrate knowledge of digital evidence types and manage forensic reporting.

UNIT I: INTRODUCTION TO CYBER CRIME

Cyber Space, Cyber Crime, Criminal Behaviour, Jurisdictional Concerns, Jurisprudential Inconsistency, eCash Security, Prepaid Cards, Stored Values Cards, Mobile Payments, ATM Frauds, Internet Gambling.

UNIT II: CYBER FORENSICS

Digital Devices, Hard disk, Disk characteristics, commercial piracy, soft liftin, Steganography, Trojans and Backdoors, Botnets, DoS, DDoS Attacks, Honey Pots, Malware, Virus and Worms.

UNIT III: CYBER INVESTIGATION

Concepts of Investigation, cyber investigation, Network Investigation, Investigating Computer Intrusions, Cyber Criminal profiling, Stylometric Techniques, Warranted searches, Warrantless searches, Undercover Techniques.

UNIT IV: EVIDENCE MANAGEMENT

Types of Digital Evidence, Physical Evidence, Real Evidence, Circumstantial Evidence, Evidence Collection, Evidence Analysis, Report Generation.

References:

1. Gayathri Gupta, "A Textbook of Cyber Forensics & Analytics" , S.K. Kataria & Sons 2024
2. Marjie T. Britz, “Computer Forensics and Cyber Crime”, Pearson, 2013.

3. Garima Tiwari, “Understanding Laws– Cyber Laws and Cyber Crimes”, Lexis Nexis, 2014.
4. Chuck Easttom, Jeff Taylor, “Computer Crime, Investigation, and the Law”, Course Technology, 2018.
5. Sharma, S. L. (2016). Cyber crime & cyber security. Kalyani Publishers.
6. Government of India. (2000). Information Technology Act, 2000. Universal Law Publishing.

Weblink References:

1. New Approaches to the Application of Digital Forensics in Cybersecurity: A Proposal, Kenneth Okereafor , Rania Djehaiche, https://www.researchgate.net/profile/Kennethkereafor/publication/341279338_New_Approaches_to_the_Application_of_Digital_Forensics_in_Cybersecurity_A_Proposal/links/5eb7fd1c299bf1287f782c45/New-Approaches-to-the-Application-of-Digital-Forensics-inCybersecurity-A-Proposal.pdf
2. National Institute of Standards and Technology (NIST). (n.d.). Digital forensics. https://www.nist.gov/digital-forensics
3. INTERPOL. (n.d.). Cybercrime. https://www.interpol.int/Crimes/Cybercrime
4. Indian Computer Emergency Response Team (CERT-In). (n.d.). Official website. https://www.cert-in.org.in
5. SANS Institute. (n.d.). Digital forensics & incident response. https:// www.sans.org/digital-forensics-incident-response/

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	2	1	3	2	2	2	2
CO2	3	3	2	2	2	1	2	1	2	2
CO3	3	3	3	3	2	2	3	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3
Weighted Average	2.75	2.75	2.5	2.5	1.75	1.75	2.25	1.75	2.5	2.5

SC DIGITAL IMAGE PROCESSING 3:0:1

Total: 60 hours

Objectives:

- To understand digital image fundamentals and pixel relationships.
- Apply spatial domain techniques for image enhancement.
- Understand the mathematical foundations of Fourier analysis (series, transform) and its historical significance.
- To Design morphological algorithms for feature extraction.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Master the fundamentals of digital image processing, sampling, quantization, and pixel operations.

CO2: Utilize spatial domain techniques for image enhancement.

CO3: Compute Fourier series/transforms for continuous and sampled signals.

CO4: Apply grayscale morphology for texture analysis and advanced image enhancement.

UNIT I: INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS

Introduction and Digital Image Fundamentals Introduction to Digital Image Processing, The Origins of Digital Image Processing, Examples of Fields that use Digital Image Processing, Fundamental steps in Digital Image Processing, Basic working of Image Processing model, Elements of Visual Perception, Image Sampling and Quantization, Some Basic Relationships Between Pixels.

UNIT II: IMAGE ENHANCEMENT IN SPATIAL DOMAIN

The Basics of Intensity Transformations and Spatial Filtering, Image Negatives, Log Transformations, Histogram Processing, Histogram Equalization, Histogram Matching, Local Histogram Processing ,Using Histogram Statistics for Image Enhancement. Fundamentals of Spatial Filtering, The Mechanics of Spatial Filtering, Spatial Correlation and Convolution.

UNIT III: FILTERING IN THE FREQUENCY DOMAIN

A Brief History of the Fourier Series and Transform, Preliminary Concepts, Complex Numbers, Fourier Series, Impulses and Their Sifting Property, The Fourier Transform of Functions of One Continuous Variable, Convolution, Sampling and the Fourier Transform of Sampled Functions, Aliasing, Function Reconstruction (Recovery) from Sampled Data The Discrete Fourier Transform (DFT) of One Variable, Obtaining the DFT from the Continuous Transform of a Sampled Function, Relationship Between the Sampling and Frequency Intervals.

UNIT IV: MORPHOLOGICAL IMAGE PROCESSING

Preliminaries, Erosion and Dilation, Opening and Closing,The Hit-or-Miss Transformation, Some Basic Morphological Algorithm, Boundary Extraction, Hole Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening, Skeletons, Gray-Scale Morphology.

Textbooks:

1. Digital Image Processing by Rafael C Gonzalez & Richard E Woods, 3rd Edition
2. Anil K Jain, " Fundamental of Digital Image Processing", Prentice Hall, 1989.
3. Digital Image Processing by William K Pratt

Weblink References:

1. Quantum Image Processing: Opportunities and Challenges, Yue Ruan, Xiling Xue, Yuanxia Shen, HindawiMathematical Problems in EngineeringVolume 2021, Article ID 6671613, 8 page, https:// onlinelibrary.wiley.com/doi/epdf/10.1155/2021/6671613
2. Identifying the Digital Camera from Natural Images Using Residual Noise and the Jensen–Shannon Divergence, Francisco Rodríguez-Santos, Ana L. Quintanar-Reséndiz, HindawiJournal of Electrical and Computer Engineering Volume 2022, Article ID 1574024, 14 pages.
3. NASA – Image Processing in Space Exploration. https://www.nasa.gov/content/image-processing
4. Image Processing Learning Resources (Gonzalez & Woods Companion Site) https://www.imageprocessingplace.com/
5. Kaggle – DIP Notebooks https://www.kaggle.com/code/tags/image-processing

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	1	1	1	2	2
CO2	3	3	3	3	2	1	1	1	2	2
CO3	3	3	3	3	3	1	1	1	2	2
CO4	3	3	3	3	3	1	1	1	2	2
Weighted Average	3	3	2.75	2.75	2.5	1	1	1	2	2

Practicals:

1. Develop a simple image reader and display tool using Python OpenCV.
2. Demonstrate input, processing (e.g., blurring), and output stages of an image processing model.

3. Create a pixel relationship visualization.
4. Implement **image sampling and quantization** with adjustable parameters.
5. Perform histogram processing including histogram plotting, analysis, and visualization.
6. To enhance contrast using histogram equalization techniques.
7. Use histogram statistics (mean, standard deviation) for intensity adjustment.
8. Implement DFT and display magnitude spectrum
9. Apply an ideal low-pass filter in frequency domain.
10. Apply an ideal high-pass filter in frequency domain
11. Perform inverse Fourier transform
12. Implement basic morphological operations on binary images.

SC WIRELESS SENSOR NETWORKS 3:1:0

Total: 45 hours

Objectives:

- To learn the technologies and challenges of Wireless Sensor Networks.
- To study the architecture of node and networks.
- To understand various protocols of Wireless Sensor Networks.
- To learn the topology control and positioning of nodes.

Course Outcome:

At the end of the course the students will be able to:

CO1: Comprehensive understanding of Wireless Sensor Networks, their applications, challenges.

CO2: Deep understanding of both single-node and network architectures.

CO3: Understanding of MAC Protocols in WSNs.

CO4: Comprehensive understanding of the time synchronization and enable to analyze and apply these protocols.

Unit I: INTRODUCTION TO WIRELESS SENSOR NETWORKS

What is sensor?, Why sensors required?, What is Wireless Sensor Networks?, Advantages, Applications, Types of Applications, Challenges for Wireless Sensor Networks, Why are WSNs different.

Unit II: ARCHITECTURES

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design Principles of WSNs, Gateway Concepts.

Unit III: MAC Protocols

Fundamentals of (wireless) MAC protocols, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts.

Unit IV: TIME SYNCHRONIZATION

Introduction to the time synchronization problem, Protocols based on sender/receiver synchronization, Protocols based on receiver/receiver synchronization.

References:

1. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” John Wiley, 2005.
2. Chandrakant Naikodi, Dr. Suresh L, “The Today and Future of Wsn, Ai, and Iot A Compass and Torchbearer for the Technocrats”, Bpb Publications, 2020
3. Feng Zhao and Leonidas J. Guibas, “Wireless Sensor Networks- An

Information Processing Approach", Elsevier, 2007.
4. Raghavendra, Cauligi S, Sivalingam, Krishna M, Zanti Taiev. “Wireless Sensor Networks”, Spinger 1st Edition 2004.
5. Waltenegus Dargie , Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley & Sons Publications, 2011.

Weblink References:

1. Mohammed Sulaiman BenSaleh, Raoudha Saida
" Wireless Sensor Network Design Methodologies: A Survey"
Link: https://doi.org/10.1155/2020/9592836

2. I Almomani, B Al-Kasasbeh, M Al-Akhras
" WSN-DS: a dataset for intrusion detection systems in wireless sensor networks"
Link: https://doi.org/10.1155/2016/4731953

3. Belal Al-Fuhaidi, Abdulqader M. Mohsen
"An Efficient Deployment Model for Maximizing Coverage of Heterogeneous Wireless Sensor Network Based on Harmony Search Algorithm"
Link: https://doi.org/10.1155/2020/8818826

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	1	2	1	-	1	2	1
CO2	3	2	3	2	2	1	-	-	1	1
CO3	3	2	2	2	2	-	-	1	1	1
CO4	3	2	3	3	3	2	-	-	3	1
Weighted Average	3	2.25	2.5	2.5	2.25	1	-	0.5	1.75	1

SC GREEN IT 4:0:0

Total: 45 hours

Objectives:

- Understand Green IT fundamentals and formulate environmentally responsible business strategies.
- Analyze compliance frameworks and perform Green IT audits using carbon management tools.
- Evaluate emerging green technologies and sustainability trends for environmental challenges.
- Apply Green IT strategies through case-based analysis and technology integration in real scenarios.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Describe Green IT principles and develop environmentally responsible business strategies.

CO2: Explain Green IT compliance mechanisms and perform basic carbon auditing.

CO3: Assess emerging technologies for their role in sustainable IT solutions.

CO4: Apply Green IT strategies through case studies and technology integration.

UNIT I: Green IT Fundamentals

Green IT Fundamentals: Business, IT, and the Environment – The Environment Today, IT and environment, Green enterprise characteristics, challenges of a carbon economy, Green IT Strategies: Drivers, Dimensions, and Goals – Green IT Strategies: Range of impact, developing an Environmentally Responsible Business Strategies(ERBS), KPIs in Green Strategies.

UNIT II: Green Compliance: Protocols, Standards, and Audits

Government Initiatives, Industry and vendor initiatives, IT Vendor initiatives, Green IT Audits, Undertaking Green IT Audit, Audit and Use of Carbon Emissions Management Software.

UNIT III: Emergent Carbon Issues: Technologies and Future.

Green ICT and technology trends, Nanotechnologies, Quantum/Trinary Computing, New renewable Enterprise, Security and Legal, Eco design, Biomimicry, Collaborative Environmental Intelligence.

UNIT IV: Case Study

Applying Green IT Strategies to a hospital, Preliminary Green Investigation, Green Business Objectives, SWOT, Strategic concerns of Management, Steps in developing a hospital ERBS, Green transformational elements, Technology changes, Applying mobile technologies.

Textbook:

1. Bhuvan Unhelkar, ―Green IT Strategies and Applications-Using Environmental Intelligence, CRC Press, June 2014.

References:

1. San Murugesan, G.R. Gangadharan, Harnessing Green IT : Principles and Practices, Wiley, 2012.
2. Rajeev R. Thakur, Green Computing and Green IT: A Sustainable Approach, Oxford University Press India.
3. Kalpana Sharma, Suresh Chandra Satapathy, and B. Eswara Reddy, Green Computing, Cengage Learning India.

Weblink References:

1. A Comprehensive Review of Green Computing: Past, Present, and Future Research Showmick Guha Paul; Arpa Saha; Mohammad Shamsul Arefin; Touhid Bhuiyan; Al Amin Biswas; Ahmed Wasif Reza
   https://ieeexplore.ieee.org/document/10214579
2. A Novel Energy Proficient Computing Framework for Green Computing Using Sustainable Energy Sources Ghulam Abbas; Mohammed Hatatah; Aamir Ali; Ezzeddine Touti; Ahmed Alshahir; Ali M. Elrashidi
   https://ieeexplore.ieee.org/document/10314521

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	1	1	3	1	-	-	2
CO2	2	3	2	1	2	3	-	-	1	1
CO3	1	3	2	2	3	3	-	-	2	2
CO4	2	2	3	2	2	3	1	2	2	2
Weighted Average	1.75	2.5	2.25	1.5	2.25	3	0.5	0.2	1.25	1.75

SC INTELLECTUAL PROPERTY RIGHTS 3:1:0

Total: 45 hours

Objectives:

- Explain the fundamental concepts, types, and international frameworks of Intellectual Property Rights, with emphasis on their role in science, technology, and emerging fields.
- Describe the protection mechanisms for industrial designs, trademarks, geographical indications, and trade secrets, highlighting their legal and commercial significance.
- Illustrate the principles, processes, and legal considerations related to patents in India and abroad, including case-based understanding of patent disputes.
- Examine the scope, protection, and management of copyright and related rights in both traditional and digital environments.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Interpret the need, types, and global perspective of IPR, and assess strategies for developing countries in leveraging IP for innovation.

CO2: Apply the procedures and legal frameworks for protecting industrial designs, trademarks, geographical indications, and trade secrets in real-world contexts.

CO3: Demonstrate the ability to identify patentable inventions, outline the filing process, and analyze patent disputes using national and international examples.

CO4: Analyze copyright laws, infringement issues, and licensing practices, with a focus on challenges in digital media and software.

UNIT I: Introduction to Intellectual Property Rights

Introduction to IPR: Concept, Need, IP types, WIPO, TRIPs agreement, Intellectual Property Rights strategies in Developing Countries, IPR in International Scenario, IPR in Science and Technology, IPR in semiconductor chips, IPR in new technologies.

UNIT II: Trademarks, Trade Secrets, and Emerging Areas

Industrial Designs: Overview, need for protection of a design, procedure for registration of design, Importance of Trademarks and Geographical Indications, validity for Geographical Indications in India, Protection of GIs, Trade Secrets- Definition, concept, Discovering trade secrets, Protecting Trade Secrets, Legal Development.

UNIT III: Patents and Patent Rights

Introduction to Patents: Meaning, History, Patentable and Non-Patentable Invention, Process of Patent Filing in India, Rights and Obligations of a Patentee, Patent Cooperation Treaty (PCT) and Patent Filing Abroad, Software Patents and Patentability in India and Globally, Case Studies: Indian and International Patent Disputes.

UNIT IV: Copyright and Related Rights

Introduction to Copyright: Features and Scope, Works Protected under Copyright Law, Ownership, Assignment, and Licensing of Copyright, Infringement and Remedies, Copyright in Digital Media and Software, Open Source Licensing, Case Studies: Copyright Issues in Software and Web Content.

Textbook:

1. Dr. R. Radhakrishnan and Dr. S. Balasubramanian, Intellectual Property Rights: Text and Cases, Excel Books.

References:

1. Intellectual Property Rights and Innovation: A Study of India's Legal Framework: Payal Kumari
2. Intellectual Property Rights and Innovation in India: Challenges and Opportunities: Shaktisinh V. Parmar
3. A Handbook on Laws Relating to Intellectual Property Rights in India: Published by: ICAI

Weblink References:

1. Blockchain and IoT-based architecture design for intellectual property protection Jun Lin; Wen Long; Anting Zhang; Yueting Chai
https://ieeexplore.ieee.org/document/9826692/authors#authors
2. Data Protection of Internet Enterprise Platforms in the Era of Big Data, Jiaxing Zhang; Anuo Yang; Feng Shuaishuai
https://ieeexplore.ieee.org/document/10243632
3. AI for Patents: A Novel Yet Effective and Efficient Framework for Patent Analysis, Junyoung Son; Hyeonseok Moon; Jeongwoo Lee; Seolhwa Lee; Chanjun Park; Wonkyung Jung
https://ieeexplore.ieee.org/document/9779775

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	2	2	3	3	2	2	2
CO2	2	2	2	2	2	3	3	2	2	2
CO3	2	3	3	3	3	3	3	2	3	2
CO4	2	3	3	3	3	3	3	3	3	3
Weighted Average	2	2.5	2.5	2.5	2.5	3	3	2.25	2.5	2.25

SC DATA MINING 3:1:0

Total: 45 hours

Objectives:

- To introduce the fundamentals of data mining, its challenges, and data preparation techniques.
- To study association rule mining techniques for discovering patterns in data.
- To explore classification techniques and evaluate classifier performance using decision trees, rule-based, nearest neighbour, and Bayesian approaches.
- To study various clustering techniques and algorithms for grouping and evaluating data patterns.

Course outcomes:

At the end of the course the students will be able to:

CO1: To understand data mining tasks and apply preprocessing and similarity measures on various data types.

CO2: To apply frequent item set generation and FP-Growth algorithm for association analysis.

CO3: To build and evaluate classifiers using decision trees, rule-based methods, and Bayesian techniques like Naïve Bayes.

CO4: To apply and evaluate clustering methods such as K-means, hierarchical, density-based, and graph-based algorithms.

Unit I

Introduction to data mining, Challenges, Data Mining Tasks. Data: Types of Data, Data Quality, Data Pre-processing, Measures of Similarity and Dissimilarity.

Unit II

Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FP-Growth Algorithm

Unit III

Classification: Decision Trees Induction, Evaluating the performance of a classifier, Rule Based Classifiers: Rule based classifier, How rule based classifier works, Rule ordering Scheme - How to build a Rule based classifier – Direct method for rule extraction, Indirect method for rule extraction, Nearest Neighbour Classifiers, Bayesian Classifiers – Bayes theorem, using Bayes theorem for classification, Naïve Bayes Classifier – Conditional Independence, How a Naïve Bayes classifier works

Unit IV

Clustering Analysis: Overview, Different type of clusters, K-Means – The Basic K-mean algorithm, Bisecting K-mean, K-means as an Optimization Problem, Agglomerative Hierarchical Clustering – Basic Agglomerative Hierarchical Clustering,

Specific technique,
DBSCAN – Traditional Density: Centre Based approach, Cluster Evaluation.
Cluster Analysis: Additional Issues and Algorithms: Density-Based Clustering – Grid based clustering, CLIQUE, DENCLUE, Graph Based Clustering – Sparsification, MST clustering, OPPOSSUM, Chameleon algorithm, Scalable Clustering Algorithms.

Textbook:

1. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Pearson, 2e. Department of MCA 63

References:

1. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, Morgan, Kaufmann Publisher, 3e
2. Mastering Data Mining, Michael.J.Berry, Gordon.S.Linoff, Wiley Edition, 2e.
3. Principles of Data Mining, David Hand, Heikki Mannila and Padhraic Smyth, The MIT Press.

Web link References:

1. Data Mining Methods and Applications, Kwok-Leung Tsui, et.al., https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=2bc771da303bca803ecb1f4e2431962d8ff5ce2b
2. A survey on the use of association rules mining techniques in textual social media, Jose A. Diaz - Garcia, M. Dolores Ruiz, Maria J. Martin-Bautista, https:// link.springer.com/content/pdf/10.1007/s10462-022-10196-3.pdf

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	2	2	1	1	2	1
CO2	3	2	3	2	2	2	-	-	2	1
CO3	3	3	3	3	2	2	-	-	2	1
CO4	3	3	3	3	2	2	-	-	2	1
Weighted Average	3	2.5	3	2.5	2	2	0.25	0.25	2	1

SC ENTREPRENEURSHIP DEVELOPMENT 3:1:0

Total: 45 hours

Objectives:

- To introduce the fundamental concepts of entrepreneurship and the role of entrepreneurs in economic development.
- To examine the role, challenges, and development strategies of women and rural entrepreneurs.
- To explore the psychological and behavioural aspects that motivates individuals to become entrepreneurs.
- To provide a foundational understanding of management principles, processes, and their significance in organizational success.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Students will be able to identify the characteristics and functions of entrepreneurs and understand the evolution and types of entrepreneurship in India.

CO2: Students will be able to analyze the issues faced by women and rural entrepreneurs and propose methods to support their growth and sustainability.

CO3: Students will be able to evaluate the motivational factors and traits like creativity, risk-taking, and leadership that influence entrepreneurial behavior.

CO4: Students will be able to differentiate between management and administration and apply basic management functions and principles in an entrepreneurial context.

Unit I: Entrepreneur & Entrepreneurship

Introduction, Evolution of the concept of Entrepreneur, Characteristics of successful entrepreneurs, the charms of becoming of an Entrepreneur, The Entrepreneurial Decision Process, Functions of Entrepreneur, Need for an Entrepreneur, Types of Entrepreneurs, Concept of Entrepreneurship, Growth of Entrepreneurship in India.

Unit II: Women and Rural Entrepreneurship

Concept of Women Entrepreneur, Functions of Women Entrepreneurs, Growth of Women Entrepreneurship in India, Problems of Women Entrepreneur, Developing Women Entrepreneurship, Meaning of Rural Entrepreneurship, Need for Rural Entrepreneurship, Rural Entrepreneurship / Industrialization in Retrospect, Problems of Rural Entrepreneurship. How to develop Rural Entrepreneurship.

Unit III: Entrepreneurial Motivation

Meaning of Entrepreneurial Motivation, Motivational Cycle or Process, Entrepreneurial Motivating Factors, Entrepreneurial Motivational Behavior–Creativity, Self-Efficacy, Locus of control, Risk taking, Leadership, Communication.

Unit IV: Management

Meaning of Management, Characteristics of Management, Difference between Management and Administration, Management as Science, Art and Profession, Importance of Management, Scope of Management, Functions of Management, Management Process, Principles of Management.

References:

1. Entrepreneurial Development, S.SKhanka, 1st edition, S.Chand Publication.
2. Dynamics of Entrepreneurship Development, Vasant Desai, 6th edition, Himayala Publishing House.
3. Entrepreneurship: New Venture Creation ,David H. Holt, Pearson Publication.

Weblink References:

1. Daniela Gimenez-Jimenez, Martina Harc, Students' Sustainable Entrepreneurship Intentions: The Role of Sustainable Values and Culture, The Journal of Entrepreneurship, 2024. https://doi.org/10.1177/09713557241232246
2. Minh Pham, et. al., The impact of entrepreneurship knowledge on students' entrepreneurial Intention formation and the moderating role of technological innovativeness, Journal of Innovation and Entrepreneurship, Springer Open, 25 November 2023. https://innovation-entrepreneurship.springeropen.com/articles/10.1186/s13731-023-00351-7
3. Alberto Michele Felicetti, Digital innovation in entrepreneurial firms: a Systematic literature review, Springer Link, 21 March 2023. https://link.springer.com/article/10.1007/s11846-023-00638-9

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	3	2	1	2	1	1	1	1
CO2	1	1	1	1	1	2	1	2	1	2
CO3	-	1	2	1	1	2	1	1	1	1
CO4	-	1	1	1	1	1	1	3	2	1
Weighted Average	0.75	1	1.75	1.5	1	1.75	1	1.75	1.25	1.25

SC BUSINESS INTELLIGENCE 3:1:0

Total: 45 hours

Objectives:

- To Understand the fundamental concepts of Business Intelligence and it's evolution
- To Analyze BI user models, reporting tools, and OLAP architecture.
- Evaluate the BI lifecycle, including strategy formulation, technology selection for enterprise and departmental BI solutions.
- To Get an overview of various technologies associated with Business Intelligence.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Explain the core principles of Business Intelligence and its historical development

CO2: Leverage BI reporting, querying and OLAP techniques to analyze business data.

CO3: Design a structured BI strategy by evaluating organizational capabilities, infrastructure, and tech needs.

CO4: Compare and contrast various BI implementations in major companies.

UNIT I: INTRODUCTION AND BASICS

Understanding Business Intelligence: Limited Resources, Limitless Decisions, Business Intelligence Defined: No CIA Experience Required, BI's Big Four, The BI Value Proposition, A Brief History of BI, Data collection from stone tablets to databases, BI's Split Personality: Business and Technology, BI: The people perspective; Meeting the BI Challenge: The BI Spectrum- Enterprise versus departmental BI.

UNIT II: BUSINESS INTELLIGENCE USER MODELS AND OLAP

Basic Reporting and Querying: Querying and reporting in context, Reporting and querying toolkit characteristics, Self-Service Reporting and Querying, Building and using ad-hoc queries, building simple on-demand self-service reports, Adding capabilities through managed querying/reporting, Data Access: Classical BI: pull oriented information access, Emerging BI: pushing critical insights to users. OLAP: Online Analytical Processing: OLAP in Context, OLAP Application Functionality, OLAP Architecture.

UNIT III: THE BI LIFECYCLE

The BI Big Picture: So Many Methodologies, So Little Time, Starting at the beginning, The exception to the rule: Micro-BI, Customizing BI for Your Needs: Your not-so-clean slate, Initial activities, Selecting BI products and technologies, Taking a Closer Look at BI Strategy: The Big Picture, Your Current BI Capabilities (or Lack Thereof).

UNIT IV: BI AND TECHNOLOGY

Data Warehouses and BI, consolidating information across silos, Structuring data to enable BI, Data Models, Dimensional data model, Other kinds of data models, Data Marts, Operational Data Stores, The BI Software Marketplace - A little history, Mergers and acquisitions Major Software Companies in BI – Oracle, Microsoft, SAP, IBM.

References:

1. Business Intelligence For Dummies- Swain Scheps, 1st edition, Wiley publishing.
2. Business Intelligence and Analytics: Systems for Decision Support, Ramesh Shardha. 10th edition, Pearson, 2014.
3. Business analytics for managers: taking business intelligence beyond reporting, Gert H.N,2nd edition, Wiley Publishing.

Weblink References:

1. Hussain Al-Aqrabi, et. al., Cloud BI: Future of business intelligence in the Cloud, Journal of Computer and System Sciences, ELSEVIER. https:// www.sciencedirect.com/science/article/pii/S0022000014001007
2. Jasdeep Bhatia, Business Intelligence: Operations, User Types, and Advantages, 2023. https://pwskills.com/blog/business-intelligence-operations-user-types-andadvantages-2023/
3. Altexsoft, What is OLAP: A Complete Guide to Online Analytical Processing. https://www.altexsoft.com/blog/olap-online-analytical-processing/

Course Articulation Matrix:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	2	2	1	1	1	1	1	1	1	1
CO 2	3	2	1	2	1	1	1	1	1	1
CO 3	3	3	1	2	1	1	1	1	1	1
CO 4	3	3	1	1	1	1	1	1	1	1
Weighted Average	2.75	2.5	1	1.5	1	1	1	1	1	1

SC ETHICS, VALUES AND INDIAN KNOWLEDGE SYSTEM 3:1:0

Total: 45 hours

Objectives:

- Understand the fundamentals of Human values.
- Know the concepts of engineering ethics and responsibilities.
- To understand the significance and key practices of the Indian Knowledge System in irrigation, water management, physical structures, and surgery.
- To introduce students to the health, wellness, Ayurveda, psychology, and consciousness aspects of IKS for holistic well-being.

Course outcomes:

At the end of the course the students will be able to:

CO1: Explain the core concepts of human values, including morals, ethics, integrity, work ethics, respect, honesty, courage, valuing time, cooperation, commitment, self-confidence, workplace challenges, and spirituality.

CO2: Identify and analyze ethical principles in engineering, recognize moral dilemmas, and describe the roles, responsibilities, and characteristics of professional engineers.

CO3: Describe the importance, history, and components of the Indian Knowledge System (IKS), including traditional practices in irrigation, water management, physical structures, and surgical techniques.

CO4: Demonstrate understanding of the interdisciplinary aspects of Humanities and Social Sciences within the IKS framework, covering health, wellness, Ayurveda, psychology, consciousness, and the role of Yoga as a way of life.

Unit I: Human Values

Objectives, Morals, Values, Ethics, Integrity, Work ethics, Respect for others, living peacefully, Honesty, Courage, Valuing time, Cooperation, Commitment, Self-confidence, Challenges in the work place, Spirituality.

Unit II: Engineering Ethics

Overview, Senses of engineering ethics, variety of moral issues, types of enquires, moral dilemmas, moral autonomy, moral development, Profession: Types, characteristics professional role model.

Unit III: Indian Knowledge System – An Introduction

Importance, Definition, IKS Corpus, Historicity of IKS, Irrigation Systems and Practices in South India, Physical Structures in India, Irrigation and Water management, Surgical Techniques.

Unit IV: Humanities and Social Science in Indian Knowledge System

Health, Wellness and Psychology, Ayurveda, Tri-Dosas, Disease Management, Yoga- way of life, Indian Approach to Psychology, Consciousness-the true nature of

an individual, Consciousness studies- Issues.

References:

1. R. S. Naagarazan, A Textbook on Professional Ethics and Human Values, New Age international publishers.
2. B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, Introduction to Indian Knowledge System, Concepts and Applications, PHI.

Weblink References:

1. Teachers' Perception of Professional Ethics and Its Impact on Their Professionalism
   https://www.google.com/search?q=professional+ethics+peer+journal+artical&rlz=1C1CHBD_enIN784IN784&oq=professional+ethics+peer+journal+artical&aqs=chrome..69i57j33i10i160l2.32789j0j15&sourceid=chrome&ie=UTF-8#ip=1
2. Effective practices for improving services professional's ethical behaviors: A multiple method study.
   https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2022.1042142/full
3. Indian Knowledge System and Globalization: An Intensive Study
   https://www.ijrrjournal.com/IJRR_Vol.12_Issue.1_Jan2025/IJRR29.pdf?utm_source=chatgpt.com
   Integrating Indian Knowledge Systems into Modern Education: An Analysis of NEP 2020
   https://eprajournals.com/pdf/fm/jpanel/upload/2024/June/202406-01-017557

Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	2	1	1	2	3	2	1	2
CO2	1	2	3	2	1	2	3	2	2	2
CO3	1	1	1	1	1	3	2	1	2	2
CO4	1	1	2	2	1	3	2	2	2	3
Weighted Average	1	1.25	2	1.5	1	2.5	2.5	1.75	1.75	2.25

SC CYBER SECURITY 3:1:0

Total: 45 hours

Objectives:

- Understand cybercrime, legal issues and cyber offences.
- Make the students understand the various crimes using mobiles.
- Learn the tools and methods employed for committing cyber-crime.
- To introduce the concepts, techniques, and threats associated with phishing and identity theft, and to equip them with the knowledge of preventive strategies and countermeasures to safeguard digital identities.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Understand the concept, classification and legal aspects of cybercrime to analyze the nature and behavior of cybercriminals from Indian and Global perspectives.

CO2: Evaluate the security threats and challenges related to mobile and wireless devices and propose appropriate organizational policies and technical measures to mitigate mobile-based cybercrimes.

CO3: Identify and analyze various tools and techniques used in cyberattacks such as spyware, DoS/DDoS, and SQL injection and understand their implications for cybersecurity.

CO4: Understand and analyze the methods and impacts of phishing and identity theft, and apply appropriate countermeasures to enhance personal and organizational cybersecurity.

Unit I: Cybercrime and Cyber offenses

Cybercrime: Introduction, Cybercrime definition and origins of the word, Cybercrime and information security, who are Cybercriminals, Classifications of cybercrimes, Cybercrime: The legal perspectives, Cybercrimes: An Indian perspective, Cybercrime and the Indian ITA 2000, a global Perspective on cybercrimes.

Cyber offenses: Introduction, How criminal plan the attacks, Social Engineering, Cyber stalking, Cybercafé and Cybercrimes, Botnets: the Fuel for Cybercrime.

Unit II: Cybercrime: Mobile And Wireless Devices

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Unit III: Tools and Methods Used in Cybercrime

Introduction, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks.

Unit IV: Phishing and Identity Theft

Phishing, how phishing works, Phishing techniques (e.g., spear-phishing), Types of phishing scams, Phishing toolkits and "spy-phishing", Counter measures to defend against phishing. Identity Theft (ID Theft)- Definition and Scope, Personally Identifiable Information (PII), Techniques used in ID theft, Types of identity theft, Counter measures to prevent identity misuse, How to erase traces of your online identity to protect privacy.

References:

1. Cyber Security, Nina Godbole, Sunit Belapure, 1st edition, Wiley Publication.
2. Nina Godbole, Information Systems Security, 1st edition, Wiley India.
3. Kennetch J. Knapp, "Cyber Security & Global Information Assurance", Information Science Publishing.
4. Principles of Information Security, Michael E. Whitman,Herbert J. Mattord, 6th edition, Cengage Learning.
5. Cryptography and Network Security, William Stallings, 4th edition, Pearson Publication.

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   https://doi.org/10.1093/cybsec/tyab019
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2. Credit Card Fraud Detection on Original European Credit Card Holder Dataset Using Ensemble Machine Learning Technique Yih Bing Chu * , Zhi Min Lim, Bryan Keane, Ping Hao Kong, Ahmed Rafat Elkilany, Osama Hisham Abusetta Journal of Cyber Security 2023
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3. A Study of Cyber Security Threats, Challenges in Different Fields and its Prospective Solutions: A Review Val Hyginus U. Eze1, Chinyere Nneoma Ugwu1 and Ifeanyi Cornelius INOSR Scientific Research 9(1):13-24, 2023. 13 ©INOSR PUBLICATIONS International Network Organization for Scientific Research

https://www.researchgate.net/publication/367742804_A_Study_of_Cyber_Security_Threats_Challenges_in_Different_Fields_and_its_Prospective_Solutions_A_Review

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	1	2	1	2	2	1	1	1	1
CO2	3	1	3	3	2	2	1	1	1	1
CO3	2	1	-	2	2	1	-	1	1	-
CO4	1	1	2	2	2	1	-	1	1	-
Weighted Average	2	1	1.75	2	2	1.5	0.5	1	1	0.5

SC SIMULATION AND MODELING 3:1:0

Total: 45 hours

Objectives:

- Understand the basic principles of Simulation, system components and its applications.
- Learn Properties of Random numbers, algorithms to generate Random numbers and Tests for Random numbers. .
- Understand different methods for random Variant generation.
- Explore Model Building, Verification and Validation of simulation models and also understand the different types of simulations with respect to output analysis.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Analyze the different Components of System and identify the Applications of simulation.

CO2: Implement different algorithms associated with generation of Random numbers and test for random numbers.

CO3: Implement different methods of generating the Random Variants.

CO4: Analyze the different techniques in Verification and Validation of simulation models and the output analysis for different types of Simulations.

Unit I: Introduction to Simulation

Definition of Simulation, Simulation as an Appropriate and In appropriate tool, Applications of Simulation; Systems and System Environment, Components of a system, Model of a system, types and examples; discrete and continuous systems.

Unit II: Random Number Generation

Properties of Random Numbers, Generation of Pseudo-Random Numbers, Techniques for Generating Random Numbers, Tests for Random Numbers (Algorithms and Problems)- Frequency tests, Runs Tests, Gap tests.

Unit III: Random Variate Generation

Inverse Transform Technique, Direct Transformation for the normal Distribution; Convolution Method, Acceptance-Rejection Technique.

Unit IV: Verification and Validation of Simulation Models

Model Building, Verification and Validation, Verification of Simulation Models, Calibration and Validation of models – Validating Input – Output Transformations; Output Analysis for a Single Model – Types of Simulations with Respect to Output Analysis, Output Analysis for Terminating Simulations, Output Analysis for steady state Simulations – Replication Method.

References:

1. Discrete Event System Simulation – Jerry Banks, John S Carson II, Barry LNelson, DavidM Nicol, Pearson Education Asia.
2. System Simulation - Geoffrey Gordon, Prentice Hall India.
3. System Simulation with Digital Computers - N. Deo, PHI.

Weblink Reference:

1. Ji Zhang, et.al., "Information Exchange Pairs Simulation Method Based on Discrete Event Simulation for Autonomous Transportation System" https://www.hindawi.com/journals/jat/2023/6909964/

Course Articulation Matrix:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	2	1	1	1	1	1	1	1	2	2
CO2	3	3	3	3	3	-	1	1	1	1
CO3	2	2	2	2	2	-	1	-	1	1
CO4	2	2	2	1	2	-	1	-	1	1
Weighted Average	2.25	2	2	1.75	2	1	1	1	1.25	1.25

SC SOFTWARE ENGINEERING 3:1:0

Total: 45 hours

Objectives:

- Understand the fundamental concepts of software, the software engineering process, and traditional development models.
- Learn the principles of agile development, including Scrum and DevOps practices for modern software delivery.
- Gain the ability to analyze requirements and develop appropriate models and design strategies.
- Explore techniques for assuring software quality and apply effective software testing strategies.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Explain the nature of software and describe various software process models used in traditional software engineering.

CO2: Apply agile practices like extreme programming, user stories, and DevOps for iterative and continuous software development.

CO3: Perform requirements analysis and develop structured and object-oriented models using UML and other modelling techniques.

CO4: Conduct software quality assurance and testing activities using appropriate verification, validation, and debugging techniques.

Unit I: Software, Software Engineering and Process Models

The Nature of Software, The Unique Nature of WebApps, Software Engineering, The Software Process, Software Engineering Practice, Software Myths, Prescriptive Process Models.

Unit II: Agile Development

Agile process model, Agility and Cost of Change, Agile Process, Extreme Programming, User stories, Brief introduction to Scrum, Introduction to DevOps - DevOps and Agile, Minimum Viable Product - Application Deployment - Continuous Integration - Continuous Delivery.

Unit III: Requirements Modelling & Design

Requirements Analysis, Scenario – Based Modelling, UML Models that supplement the Use Case, Data Modelling Concepts, Requirements Modelling Strategies, Flow-oriented Modelling, Creating a behavioural model, Design concepts, Design Model.

Unit IV: Software Quality Assurance & Testing

Software Quality Assurance: Elements of Software Quality Assurance, SQA Tasks, Goals, Metrics, Formal Approaches to SQA, Statistical SQA, Software Reliability.

Software Testing : Verification & Validation, Software Testing Strategy—The Big

Picture, Test strategies for conventional software, OO software and WebApps, Validation Testing, System testing, The Debugging process, White box testing, Black box testing.

References:

1. Software Engineering, A Practioner's Approach - Roger S Pressman, 7th Edition, McGrawHill Education Pvt. Limited.
2. Software Engineering - Ian Sommerville, 8th Edition, Pearson Education Ltd.
3. Fundamentals of software engineering - Rajib Mall, Phi learning Pvt. Ltd, 3rd edition.
4. The DevOps Handbook - by Gene Kim, Jez Humble, Patrick Debois, and Willis Willis.
5. What is DevOps? - by Mike Loukides.
6. The DevOps Handbook - by John Willis, Patrick Debois, Jez Humble, Gene Kim.

Weblink References:

1. Insights into an Emerging Software Methodology: DevOps
   Link- https://ieeexplore.ieee.org/document/10391992
   Published in: 2023 7th International Conference On Computing, Communication, Control And Automation (ICCUBEA)
2. A Case Study of DevOps Adoption within a Large Financial Organisation
   Link- https://ieeexplore.ieee.org/document/10336327
   Published in: 2023 IEEE International Conference on Software Maintenance and Evolution (ICSME)
3. State-of-the-Art Review on Current Approaches to Female Inclusiveness in Software Engineering and Computer Science in Higher Education
   Link- https://ieeexplore.ieee.org/document/10373034 Published in: IEEE Access (Volume: 12)

1. Attribution-based Personas in Virtual Software Engineering Education
   Link- https://ieeexplore.ieee.org/document/10172670
   Published in: 2023 IEEE/ACM 45th International Conference on Software Engineering: Software Engineering Education and Training (ICSE-SEET)
2. Attribution-based Personas in Virtual Software Engineering Education
   Link- https://ieeexplore.ieee.org/document/10172670
   Published in: 2023 IEEE/ACM 45th International Conference on Software Engineering: Software Engineering Education and Training (ICSE-SEET)

Course Articulation Matrix:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	1	2	2	2	1	2	1	3	2
CO 2	2	1	2	2	2	1	1	1	2	1
CO 3	2	2	3	2	3	1	1	1	2	1
CO 4	2	1	2	2	1	1	2	1	2	2
Weighted Average	2.25	1.25	2.25	2	2	1	1.5	1	2.25	1.5

SC RESEARCH METHODOLOGY 3:1:0

Total: 45 hours

Objectives:

- To understand the fundamentals of research methodology, including types, processes, and significance in scientific inquiry.
- Formulate a well-defined research problem through literature review and theoretical framework development.
- To Design an effective research strategy, including sampling techniques and data collection methods.
- To Analyze ethical considerations in research, including plagiarism, publication ethics, and proper data interpretation.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Select appropriate research methodologies and systematically articulate the key steps in the research process.

CO2: Analyze the role of literature review in research and demonstrate the ability to conduct an effective literature search.

CO3: Compare and contrast various research designs, sampling techniques, measurement and scaling methods.

CO4: Evaluate ethical issues in research publication, including plagiarism, journal selection, and proper data interpretation.

UNIT I: RESEARCH METHODOLOGY

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

UNIT II: DEFINING THE RESEARCH PROBLEM RESEARCH PROBLEM

Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. Reviewing the literature: Establishing context and theoretical foundation of the literature review in research, Emphasise clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Process of literature review, Searching the existing literature, Reviewing the selected literature, Developing a theoretical framework.

UNIT III: RESEARCH DESIGN

Meaning of Research Design, Need for Research Design, Features of a Good Design,

Important Concepts Relating to Research Design, Different Research Designs, Design of Sample Surveys: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

UNIT IV: DATA COLLECTION

Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection. Interpretation: Meaning of Interpretation, Technique of Interpretation, Significance of report writing, Different steps in writing report. Interpretation of Data and Paper Writing- Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

References:

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018.
2. Research Methodology a step-by- step guide for beginners. (For the topic Reviewing the literature under module II Ranjit Kumar SAGE Publications Ltd 3rd Edition, 2011 Study Material.
3. Research Methods: the concise knowledge base Trochim, Atomic Dog Publishing, 2005.
4. Conducting Research Literature Reviews: From the Internet to Paper Fink A Sage Publications, 2009.

Weblink References:

1. https://www.ijrrjournal.com/IJRR_Vol.6_Issue.3_March2019/IJRR0011.pdf
2. https://www.researchgate.net/publication/361807570_An_Study_of_Research_Methodology
3. https://www.sciencedirect.com/science/article/pii/S0148296319304564
4. https://libguides.usc.edu/writingguide/methodology
5. https://mitcommlab.mit.edu/be/commkit/journal-article/
6. https://www.coursera.org/learn/sciwrite

Course Articulation Matrix:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO1	3	2	2	1	1	2	2	1	2	1
CO2	-	2	1	1	1	1	1	1	3	1
CO3	1	2	1	1	1	1	1	1	1	1
CO4	2	1	1	1	1	2	1	1	1	1
Weighted Average	2	1.75	1.25	1	1	1.5	1.25	1	1.75	1

SC NPTEL MOOC COURSE 4 Credits

NPTEL Certification Courses (MOOC Courses) NPTEL (National Programme on Technology Enhanced Learning) is a joint initiative of the IITs and IISc. Through this initiative, online courses and certification in various topics are offered to the students andscholars to enrich their knowledge in various domains.

Students shall submit certificates showing the credit points (no. of week course) earned through SWAYAM MOOCs to the Head of the department.

OE Effective Communication and Language Proficiency 3:1:0

Total: 45 hours

Objectives:

- Explain the principles, processes, and barriers of communication to improve effectiveness in professional and organizational contexts.
- Demonstrate effective oral communication through active listening, confident speaking, and the appropriate use of non-verbal cues in diverse professional situations.
- Develop clear, coherent, and engaging written communication for various professional formats, applying correct structure and style.
- Apply precise vocabulary, correct sentence structures, and appropriate tone to enhance clarity, professionalism, and impact in communication.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Demonstrate an understanding of the fundamentals, forms, and processes of communication, including overcoming common barriers.

CO2: Apply effective listening and speaking techniques in professional contexts, including group discussions, and public speaking.

CO3: Use precise vocabulary, clear sentence construction, appropriate tone, and proofreading skills to enhance professional communication.

CO4: Compose structured and coherent written communication suited for professional purposes.

Unit I: Fundamentals of Communication

Introduction, Definition, Process, Importance, Purpose, Different forms of Communication, Communication Network in an Organization, Barriers to Communication.

Unit II: Oral Communication Skills

Listening Skills: Introduction, Poor Listening vs Effective Listening, Advantages, Process, Types, Barriers, Five Steps to Active Listening.

Speaking Skills: Non-Verbal Communication, Group Discussions, Public Speaking, Selecting an Appropriate Method, Visual Aids and Illustrations, Delivering Different Types of Speeches.

Unit III: English Language Essentials for Communication

Importance of clear and precise English in professional contexts, vocabulary building for effective expression, sentence construction for clarity, and polishing professional communication through tone adjustment and proofreading.

Unit IV: Writing Skills

Structure of a Paragraph, Construction of a Paragraph, Memos, Email Writing,

Advertising, Movie Review, Book Review.

Textbook:

1. Kulkarni, A. B. (2018). Professional communication skills. Orient BlackSwan.

References:

1. Labade, S., & Dhanavel, S. P. (2014). Communication skills in English. Orient BlackSwan.
2. Raman, M., & Sharma, S. (2017). Technical communication: Principles and practice (3rd ed.). Oxford University Press.
3. Kaul, A. (2015). Effective business communication. Prentice-Hall of India.
4. Bovee, C. L., & Thill, J. V. (2016). Business communication today (13th ed.). Pearson Education.

Weblink references:

1. Borchers, T. A., & Hundley, H. L. (2020). Persuasion in Everyday Life (3rd ed.). Minnesota State University, Moorhead. Free PDF via OER Commons. https://open.umn.edu/opentextbooks/textbooks/persuasion-in-everyday-life-3rd-edition.
2. McLean, S. (2010). Business Communication for Success. University of Minnesota Libraries Publishing. https://open.lib.umn.edu/businesscommunication/
3. Borchers, T. A., & Hundley, H. L. (2019). Small Group Communication: Forming to Performing. Minnesota State University, Moorhead. https://open.lib.umn.edu/smallgroup/
4. Boundless. (n.d.). Boundless Communications.
   Covers speech, rhetoric, interpersonal communication, and listening skills. https://www.boundless.com/communications/

Course Articulation Matrix:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	1	2	2	1	1	2	2	3	2	2
CO 2	1	2	3	2	1	2	2	3	2	2
CO 3	1	2	2	1	1	2	3	3	2	2
CO 4	1	2	2	1	1	2	2	3	3	2
Weighted Average	1	2	2.25	1.25	1	2	2.25	3	2.25	2

OE E-COMMERCE 3:1:0

Total: 45 hours

Objectives:

- To impart knowledge on E-Commerce.
- To provide an overview of Business Strategy in E-Commerce.
- To provide knowledge of Internet and Webpage to establish a career in E-commerce.
- Understand the Legal and Ethical Issues in E – commerce.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Analyse the impact of E-commerce on business models and strategy

CO2: Understand the various Business Strategies including, Technology, e-Commerce Implementation, e-commerce evaluation.

CO3: Understand the Internet and Webpage.

CO4: Recognize and discuss global E-commerce issues.

Unit I: Introduction to Electronic Commerce

Scope, Definition, Trade Cycle, Electronic Markets, EDI, Internet Commerce.

Unit II: Business Strategy

Introduction, Strategic Implications, Technology, Business Environment, Capability, Strategy formulation and Implementation planning, e-Commerce Implementation, e-commerce evaluation.

Unit III: The Internet

The Development of the Internet, A page on the web, HTML, Client side Scripting, Server side Scripting.

Unit IV: Legal and Ethical Issues

Ethical Issues in the Digital Economy, Cyberstalking, Cybersquatting, Phishing; Application Fraud, Skimming, Copyright violation, Internet Gambling, Threats children, Loss of Privacy, Cookies and Privacy.

References:

1. E - Commerce: Strategy, Technologies and Applications, David Whiteley.
2. E Commerce: An Indian Perspective, P.T. Joseph, S.J, VII Edition.
3. E-commerce: The Cutting Edge of Business, K. K. Bajaj and Debjani Nag,2nd Edition, McGraw Hill.
4. Handbook of Electronic Commerce, Shaw et al., Springer.
5. Global Electronic Commerce- Theory and Case Studies, C. Westland and T. H. K. Clark, University Press.

6. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Sunit Belapure and Nina Godbole, Wiley India.

Web link References:

1. Use of E – Commerce in the World of Business
   https://journal.pandawan.id/sabda/article/view/273/259+
2. A Customer-Centric View of E-Commerce Security and Privacy
   https://www.mdpi.com/2076-3417/13/2/1020
3. Scope of e-Business & e-Commerce to Business and Modern Life View of Scope of e-Business & e-Commerce to Business and Modern Life (jisma.org)
   https://jisma.org/index.php/jisma/article/view/261/58
   https://onlinecourses.swayam2.ac.in/cec19_cm01/preview

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	1	2	2	2	2	1	1	2	2
CO2	2	1	2	2	2	1	1	1	1	1
CO3	2	1	1	1	2	1	1	1	1	1
CO4	2	1	2	2	2	1	1	1	1	2
Weighted Average	1.75	1	1.75	1.75	2	1.25	1	1	1.25	1.5

OE OFFICE AUTOMATION 3:1:0

Total: 45 hours

Objectives:

- Provide a basic introduction to computers and computing environment.
- Enable the students in crafting professional documents using word pre-processors.
- Enable students use spreadsheets for tabulating and calculating data and create graphical representations of data.
- Enable students to design professional presentations.

Course Outcomes:

At the end of the course the students will be able to:

CO1: Understand the basics of computer hardware and software.

CO2: Prepare documents of different types.

CO3: Ability to develop and use spreadsheets for tabulating and analysing for productivity.

CO4: Prepare presentations.

UNIT I: BASICS OF COMPUTER

Introduction to Computer: Definition - History & Generation of Computer (From First to 5th) -Applications of Computer – Advantages of Computer – Terms related to Computer – Characteristics of Computer: Speed, Storage, Versatility and Diligence – Hardware & Software. Block Diagram and Working Principle of Computer - Types of Computer: On the Basis of Working - Analog, Digital & Hybrid, On the Basis of Size - Main frame, Mini Computer, Super Computer, Work station, Micro Computer, Desktop Computer, Laptop Computer, Palmtop Computer; On the basis of Processor – XT, AT & Pentium(i3, i5, i7,so on); Memory: Units, Representation, Types - Primary memory: RAM, ROM, PROM, EPROM, EEPROM, DDR Secondary memory: Hard disk, CD, DVD, Blue ray Disc, Pen Drive Magnetic tape & Zip disk – CPU: Components of CPU - Mother board, Hard disk, RAM, ROM, Processor, SMPS & Connecting wire - Graphics Card, Sound Card, Network Card – Modem; Input, Output devices: Keyboard, Mouse, Scanner, Digital Camera, Joystick, Pen drive, Monitor, Printer, Plotter – Connecting port – Serial, parallel – USB port.

UNIT II: MS-WORD

MS Word - Working with Documents -Opening & Saving files, Editing text documents, Inserting, Deleting, Cut, Copy, Paste, Undo, Redo, Find, Search, Replace, Formatting page & setting Margins, Converting files to different formats, Using Tool bars, Ruler, Using Icons, using help, Formatting Documents - Setting Font styles, Font selection- style, size, colour etc, Type face - Bold, Italic, Underline, Case settings, Highlighting, Special symbols, Setting Paragraph style,

Alignments, Indents, Line Space, Margins, Bullets & Numbering. Setting Page style - Formatting Page, Page tab, Margins, Layout settings, Paper tray, Border & Shading, Columns, Header & footer, Setting Footnotes & end notes – Shortcut Keys; Inserting manual page break, Wrapping, Setting Document styles, Page Numbering, date & Time, Author etc., Creating Tables- Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula, Drawing - Inserting ClipArts, Pictures/Files etc., Tools – Word Completion, Spell Checks, Mail merge, Printing Documents – Shortcut keys.

Unit III: MS-EXCEL

MS Excel: Spread Sheet & its Applications, Opening Spreadsheet, Menus - main menu, Formula Editing, Formatting, Toolbars, Using Icons, Using help, Shortcuts, Spreadsheet types. Working with Spreadsheets- opening, Saving files, setting Margins, Converting files to different formats (importing, exporting, sending files to others), Spread sheet addressing - Rows, Columns & Cells, Referring Cells & Selecting Cells – Shortcut Keys. Entering & Deleting Data- Entering data, Cut, Copy, Paste, Undo, Redo, Filling Continuous rows, columns, Highlighting values, Find, Search & replace, Inserting Data, Insert Cells, Column, rows & sheets, Symbols, Data from external files, Frames, Clipart, Pictures, Files etc, Inserting Functions, Setting Formula - finding total in a column or row, Mathematical operations (Addition, Subtraction, Multiplication, Division, Exponentiation), Using other Formulae. Formatting Spreadsheets- Labelling columns & rows, Formatting- Cell, row, column & Sheet, Category - Alignment, Font, Border & Shading, Hiding/ Locking Cells, Anchoring objects, Formatting layout for Graphics, Clipart etc., Worksheet Row & Column Headers, Sheet Name, Row height & Column width, Visibility - Row, Column, Sheet, Security, Sheet Formatting & style, Sheet background, Colour etc, Borders & Shading – Shortcut keys. Working with sheets – Sorting, Filtering, Validation, Consolidation, and Subtotal. Creating Charts - Drawing.

UNIT IV- MS Power point

MS Power point: Introduction to presentation – Opening new presentation, Different presentation templates, Setting backgrounds, Selecting presentation layouts. Creating a presentation – Setting Presentation style, Adding text to the Presentation. Formatting a Presentation - Adding style, Colour, gradient fills, Arranging objects, Adding Header & Footer, Slide Background, Slide layout. Adding Graphics to the Presentation- Inserting pictures, movies, tables etc into presentation, Drawing Pictures using Draw. Adding Effects to the Presentation- Setting Animation & transition effect. Printing Handouts, Generating Standalone Presentation viewer.

References:

1. MS Office for Everyone – Sanjay Saxena, Vikas Publishing House.

2. Step by Step Microsoft Office XP, PHI.

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	2	2	1	-	1	1	2
CO2	3	2	1	2	2	1	1	2	2	2
CO3	3	2	2	2	3	1	1	2	2	3
CO4	3	1	1	2	2	1	1	3	1	2
Weighted Average	3	1.75	1.25	2	2.25	1	1	2	1.5	2.25

COURSE RELATED RESEARCH ARTICLES:

Software Engineering

1. Taking the emotional pulse of software engineering —A systematic literature review of empirical studies, Mary Sánchez-Gordón , RicardoColomo-Palacios https://academic.oup.com/gigascience/articlepdf/doi/10.1093/gigascience/giz054/28698071/giz054.pdf
2. Software engineering for scientific big data analysis, Bjorn A. Gru¨ning , Samuel Lampa, Marc Vaudel and Daniel Blankenberg, https://www.researchgate.net/publication/333326758_Software_engineering_for_scientific_big_data_analysis
3. Software Engineering for Machine Learning: A Case Study, Saleema Amershi, Andrew Begel, Christian Bird, Robert DeLine, https:// ieeexplore.ieee.org /abstract/ document/ 8804457

Data Communication and Networks

1. Comprehensive review for energy efficient hierarchical routing protocols on wireless sensor networks, Springer,2018, https://link.springer.com/article/10.1007/s11276-018-1696-1
2. A Survey on Recent Advances in Transport Layer Protocols, Michele Polese and et al, IEEE2019, https://ieeexplore.ieee.org/abstract/document/8786240

Cloud Computing

1. Research on Key Technologies of Cloud Computing, Shufen Zhang, Hongcan Yan, XuebinChen, Published byElsevier, https://www.sciencedirect.com/science/article/pii/S1875389212015994
2. Open Source Solution for Cloud Computing Platform Using OpenStack, Rakesh Kumar,Neha Gupta, Shilpi Charu, Kanishk Jain, Sunil Kumar Jangir, https://www.researchgate.net/publication/263581733_Open_Source_Solution_for_Cloud_Computing_Platform_Using_OpenStack
3. The Challenges of Cloud Computing Management Information System in Academic Work, T.Rodmunkong, P.Wannapiroon,and P.Nilsook, https://www.researchgate.net/publication/273897590_The_Challenges_of_Cloud_Computing_Management_Information_System_in_Academic_Work

Cryptography and Network Security

1. A Review Paper on Cryptography, Abdalbasit Mohammed Qadir andNurhayat Varol, IEEE 2019,

   https://www.researchgate.net/profile/Abdalbasit_Mohammed/publication/334418542_A_Review_Paper_on_Cryptography/links/5db07f61299bf111d4c01521/A-Review- Paper-on- Cryptography.pdf
2. Security Evaluation of Computer Network Based on Hierarchy, Linbin Wen, International Journal of Network Security,2019,.

http://ijns.jalaxy.com.tw/contents/ijns-v21-n5/ijns-2019-v21-n5-p735-740.pdf

Internet of Things

1. A Study on Internet of Things based Applications, Deeksha Jain, P. Venkata Krishna and V. Saritha, https://www.researchgate.net/publication/227172798_A_Study_on_Internet_of_Things_bas ed_Applications
2. IoT enabled Smart Fog Computing for Vehicular Traffic Control, Akashdeep Bhardwaj, Sam Goundar, https://eudl.eu/pdf/10.4108/eai.31-10- 2018.162221
3. A Review of Smart Parking Using Internet of Things (IoT), Sahil Rupani,Nishant Doshi, https://www.sciencedirect.com/science/article/pii/S1877050919317235

Information Retrieval

1. Query expansion techniques for information retrieval: A survey, Hiteshwar Kumar Azad, Akshay Deepak, https:// www.sciencedirect.com/ science/article/pii/S0306457318305466
2. A Deep Look into neural ranking models for information retrieval, Jiafeng Guo, Yixing Fan, Liang Pang, Liu Yang, Qingyao AiHamed Zamani, Chen Wu, W.Bruce Croft, Xueqi Cheng, https:// www.sciencedirect.com/ science/article/pii/S0306457319302390
3. Fuzzy Information Retrieval Based on Continuous Bag-of-Words Model, Dong Qiu , Haihuan Jiang and Shuqiao Chen, https://www.mdpi.com/2073-8994/12/2/225

Big Data Analytics

1. Big data analytics as an operational excellence approach to enhance sustainable supply chain performance, Surajit Bag, Lincoln C. Wood, Lei Xud, Pavitra Dhamija, Yaşanur Kayikci, https:// www.sciencedirect.com/science/article/pii/S0921344919304653
2. Big data analytics and firm performance: Findings from a mixed-method approach Patrick Mikalef, Maria Boura, George Lekakos, John Krogstie, https:// www.sciencedirect.com/science/article/pii/S014829631930061X
3. The role of big data analytics in industrial Internet of Things, Muhammad Habib ur Rehman, Ibrar Yaqoo, Khaled Salah, Muhammad Imran, Prem Prakash Jayaraman, Charith Perera, https:// www.sciencedirect.com/science/article/pii/S0167739X18313645

Machine Learning

1. Computer generated images vs. digital photographs: A synergetic feature and classifier combination approach, Eric Tokuda, Helio Pedrini and Anderson Rocha, Elsevier Journal ofVis. Commun, Image R., Vol. 24, 2013, pp. 1276-1292. https:// www.sciencedirect.com/science/article/abs/pii/S1047320313001557
2. Very Deep Convolutional Networks for Large-Scale Image Recognition, Karen Simonyan and Andrew Zisserman, https://arxiv.org/pdf/1409.1556.pdf

Cyber Security:

1. Cyber Security, Rohit , Anvesh Babu , Ranjith Reddy, Sciendo, HOLISTICA Vol 10, Issue 2, 2019, https://sciendo.com/article/10.2478/hjbpa-2019-0020
2. Detecting cyber threats through social network analysis: short survey, Kirichenko Lyudmyla, Radivilova Tamara, Carlsson Anders, 2017,

   https://www.researchgate.net/publication/316766488_Detecting_cyber_threats_through_social_network_analysis_short_survey

ADDITIONAL WEB RESOURCES

Programming Paradigms https://see.stanford.edu/Course/CS107

Introduction to Robotics https://see.stanford.edu/Course/CS223A

Programming Methodology https://see.stanford.edu/Course/CS106A

Programming Abstractions https://see.stanford.edu/Course/CS106B

Programming for the Puzzled https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s095-programming-for- the-puzzled-january-iap-2018/

Machine Learning https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-867-machine-learning- fall-2006/

Machine Learning for Healthcare https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s897-machine-learning- for-healthcare-spring-2019/

Introduction to Deep Learning https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s191-introduction-to- deep-learning-january-iap-2020/

Advanced Data Structures https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-851-advanced-data- structures-spring-2012/

Kotlin Tutorial https://www.w3schools.com/kotlin/index.php

Python Programming https://www.w3schools.com/python/default.asp

Angular JS https://www.w3schools.com/angular/default.asp

Cyber Security https://www.w3schools.com/cybersecurity/index.php

Data Scientist https://www.codecademy.com/learn/paths/data-science

Analyze data with Python https://www.codecademy.com/learn/paths/analyze-data-with-python

SBRR Mahajana First Grade College (Autonomous), PG Wing
Accredited by NAAC with A Grade
Pooja Bhagavat Memorial Mahajana Education Centre
Affiliated to University Of Mysore

M.C.A
QUESTION PAPER PATTERN

Duration: 2 Hours **Max Marks**: 50

(There are 5 questions. All questions must be answered.)

Question 1

There are 8 questions and a candidate has to answer any 5 questions, each carries 2 marks. (2 questions from each unit) 5×2 =10

Question 2

There are 2 main questions (a) and (b) each carrying 10 marks. Candidate has to answer any one (a or b). This covers unit 1 of the syllabus. (Each main question can be split into sub- questions totaling 10 marks) 10 ×1=10

Question 3

There are 2 main questions (a) and (b) each carrying 10 marks. Candidate has to answer any one (a or b). This covers unit 2 of the syllabus. (Each main question can be split into sub- questions totaling 10 marks) 10 ×1=10

Question 4

There are 2 main questions (a) and (b) each carrying 10 marks. Candidate has to answer any one (a or b). This covers unit 3 of the syllabus. (Each main question can be split into sub- questions totaling 10 marks) 10 ×1=10

Question 5

There are 2 main questions (a) and (b) each carrying 10 marks. Candidate has to answer any one (a or b). This covers unit 4 of the syllabus. (Each main question can be split into sub- questions totaling 10 marks) 10 ×1=10

Department of MCA
Board of Studies - 2025

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