DEPARTMENT OF MCA
2024-2025

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.

SBRR Mahajana First Grade College (Autonomous), PG Wing

Pooja BhagavatMemorial Mahajana Education Centre

KRS Road, Metagalli, Mysuru-570016

Master of Computer Application - Regulations

2024-2025

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

Passed BCA/ Bachelor Degree in Computer Science Engineering or equivalent Degree. OR passed B.Sc./ B.Com./ B.A. with Mathematics at l0+2 Level or at Graduation Level (with additional bridge Courses as per the norms of the concerned University). Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying Examination.

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	40
Soft Core	A minimum of 32, not exceeding 36
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. Duringthe 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 C3 in 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 issaid 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 ofnotification 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.

****

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, or leader to present the technical knowledge in multi-disciplinary settings.

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

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

SBRR Mahajana First Grade College(Autonomous), PG Wing

Pooja Bhagavat Memorial Mahajana Education Centre

KRS Road, Metagalli, Mysuru-570016

Master of Computer Application

Programme Structure &Syllabus

W.e.f. 2024-2025

List of Hard Core Courses

Sl. No.	Course Title	Credit Pattern			Credits	Course Code
		L	T	P		
1	Mathematical Foundations for Computer Applications	4	0	0	4	24BH01
2	Algorithms	3	0	1	4	24BH02
3	Linux Programming	3	0	1	4	24BH03
4	Object Oriented Programming with Java	3	0	1	4	24BH04
5	Professional Communication	3	1	0	4	24BH05
6	Machine Learning with Python	3	0	1	4	24BH06
7	Advanced Computer Networks	3	1	0	4	24BH07
8	Web Technologies	3	0	1	4	24BH08
9	Major Project	0	2	6	8	24BH09

List of Soft Core Courses

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

List of Open Elective Courses

Sl. No.	Course Title	Credit Pattern			Credits	Course Code
		L	T	P		
1	World Wide Web	3	1	0	4	24BE01
2	E-Commerce	3	1	0	4	24BE02
3	Office Automation	3	1	0	4	24BE03

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

Note: Fundamentals of Computers and C Programming is a mandatory non-credit Bridge Course only for the students who have completed their Bachelor's degree program in non-computer disciplines.

Course Objective:

This course is designed to get the students equipped with the fundamentals of computer science. This course will help the students to develop the programming skills through a well-known language: C.

Course outcomes:

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

CO1. Learn the basics of Computers and its organization.

CO2. Study and implement the concept of operators, decision making statements, and loop control structures.

CO3. Learn and execute programs on functions.

CO4. Gain knowledge about pointers and execute the programs using pointers, arrays and structures.

Unit I

Computer Fundamentals: Basics of computers, basic computer organization, storage hierarchy, storage devices, input-output devices. Computer Software. Introduction to operating systems.

Unit II

Elements of C language: C character set, identifiers & keywords, data types: declaration & definition. Operators: Arithmetic relational, logical, bitwise, unary, assignment and conditional operators & their hierarchy & associativity, Data input/output. Control statements: Sequencing, Selection: if and switch statement; iteration: for, while, and do-while loop; break, continue, goto statement.

Unit III

Functions in C language: Definition, prototype, passing parameters, recursion.

Unit IV

Data structure: arrays, structures, union, strings, Arrays and Pointers.

References:

1. Reema Thareja, Computer Fundamentals and Programming in C, Third Edition,

Oxford University Press.
2. By Sumitabha Das, Computer Fundamentals and C Programming, McGrawHill.
3. Yashwant Kanitkar, Let us C, BPB Publications.
4. Pradeep k. Sinha &Priti Sinha, Computer Fundamentals, BPB Publications.
5. Byron S Gottfried, Programming with C, Tata McGrawHill.

Course Articulation Matrix:

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

HC Mathematical Foundations and Computer Applications 4:0:0

Total: 40 hours

Objectives:

- Understand various concepts of mathematical logic.
- Implement set operations and functions in programming languages.
- Develop the skills to implement algebraic structures using groups.
- Develop the basic skills of Matrices and its applications.

Course Outcomes:

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

CO1: To construct mathematical arguments using logical connectives and quantifiers.

CO2: Understand the basic concepts of Mathematical reasoning, set and functions.

CO3: Acquires knowledge of set theory, groups concepts needed for designing and Solving problems.

CO4: Understand the concepts of matrix, Eigen Values and Vectors.

UNIT I

Mathematical logic: Introduction, Statements and Notation, Connectives, Arguments, Normal Forms, Theory of Inference for the Statement Calculus, The Predicate Calculus, Inference Theory of the Predicate Calculus.

Unit II

Sets-Basic definitions - Laws of set theory - Principle of inclusion and exclusion – Partitions - Permutation and combination – Relations -Properties of relations – Equivalence relation-Matrices of relations - Closure operations on relations -n-ary relations- Functions.

Unit III

Groups – Axiom of a group – Examples and basic algebra in groups – Order of an element of a group – Isomorphism of groups – Cyclic groups– Subgroups – Cosets and Lagrange's theorem.

Unit IV

Matrices - Rank of a matrix - Solving system of equations – Echelon form of a matrix and Row reduced echelon form of matrix.- Eigen values and Eigenvectors.

References:

1. Rosen K. H., "Discrete Mathematics and its Applications", Seventh Edition, Tata McGraw-Hill, New Delhi, 2007.
2. R. P. Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2007.

3. David Makinson, “Sets, Logic and Maths for Computing”, Springer Indian Reprint, 2011.
4. Trembley, J.P. and Manohar, R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, New Delhi, 2007.

Course articulation matrix:

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

HC ALGORITHMS 3:0:1

Total: 45 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 and analyze the fundamental principles and techniques of algorithms and data structures.

CO2: Implement and evaluate basic algorithms for sorting and searching and solve using divide and conquer method.

CO3: Apply greedy algorithmic techniques to solve computational problems.

CO4: Apply algorithmic techniques such as dynamic programming and backtracking to solve computational problems.

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: Floyd's Algorithm, Travelling Sales Person problem,

Backtracking: General method, N-Queens problem, Sum of subsets problem, Hamiltonian cycles.

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	2	2	2	2	2	-	-	-	-	1
CO2	2	2	2	2	2	-	-	-	-	1
CO3	2	2	2	1	2	-	-	-	-	1
CO4	2	2	2	2	2	-	-	-	-	1
Weighted Average	2	2	2	1.75	2	-	-	-	-	1

HC LINUX PROGRAMMING 3:0:1

Total: 45 hours

Objectives:

- To introduce students to the basics of UNIX/Linux systems and shell scripting.
- To impart the knowledge of file handling and environment management in Linux.
- Understand process management and threading in Linux.

Course outcomes:

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

CO1: Develop basic skills in using and programming UNIX/Linux systems

CO2: Acquire the ability to manage files and environment settings in Linux.

CO3: Demonstrate process and thread management and synchronization in Linux.

CO4: Apply inter-process communication methods and socket programming in Linux.

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

HC OBJECT ORIENTED PROGRAMMING WITH JAVA 3:0:1

Total: 45 hours

Objectives:

- Understand the basics of Java programming, including syntax, data types, variables, and control structures.
- Explore Object-Oriented Programming (OOP) principles in Java, including classes, objects, inheritance, polymorphism, and encapsulation.
- Learn about error handling and debugging techniques to develop robust and error-free Java applications.
- Study the creation of graphical user interfaces (GUIs) using Java libraries such as Swing.

Course outcomes:

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

CO1: Develop fundamental Java programming skills and understand core concepts.

CO2: Understand and implement Java classes, objects, arrays, and methods effectively.

CO3: Understand and apply inheritance, polymorphism, packages, and exception handling in Java.

CO4: Understand and implement Java multithreading, synchronization, and collection framework usage efficiently.

Unit I

Introduction to java : Introduction to OOPs Concepts, History of java , Java Essentials , Java Virtual Machine , Java Features , Program Structure . Java Programming Constructs: Variables, Primitive Data Types, Identifiers, Keywords, Literals, Operators, Expressions Precedence Rules and Associativity, Primitive Type Conversion and Casting flow of Control. Flow of Control: Conditional Statement Loops, Branching Mechanism.

Unit II

Array: One –Dimensional, Two-Dimensional Arrays,

Classes and Objects: Classes, Objects, Difference between Objects and Classes,

Class Declaration in Java, Class Body, Creating Objects, Declaring an Object Instantiating

an Object, Initializing an Object, Methods, Method Types, Method Declaration, Method Overloading, Constructors, Constructor Overloading, Class Variable and Methods—Static Keyword.

Unit III

Inheritance and Polymorphism: Inheritance Introduction, types, Overriding Method, super Keyword, final Keyword, Abstract Class, Interfaces. Packages: Creating

Packages, Using Packages, Access Protection, Exception Handling: Introduction, Exception Types, Exception Handling Techniques: try…catch, throw Keyword, throws, finally Block

Unit IV

Multithreading in java: Introduction, thread life cycle and methods, Runnable interface, Thread Synchronization, Thread Priority, Communication between threads Collection Framework: overview, The Collection Interface: List, Set, Sorted Set, Map (Hash maps) Interface, The Collection Classes: Array List, LinkedList, HashSet, Tree Set, Accessing a Collection via an Iterator.

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.pt

   file:///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

HC PROFESSIONAL COMMUNICATION 3:1:0

Total: 40 hours

Course Objectives:

- Develop and refine verbal and written communication skills tailored for diverse Professional environments and audiences.
- Recognize and practice essential business etiquette to build strong Professional relationships and a positive workplace culture.
- Explore and utilize various technological tools to enhance the effectiveness and Visual appeal of presentations.
- Formulate and practice effective responses to common interview questions to improve performance in job interviews.

Course Outcomes:

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

CO1: Demonstrate the ability to utilize various digital communication tools effectively, enhancing professional interactions and collaboration in a mobile world.

CO2: Exhibit effective interpersonal communication and teamwork strategies, applying business etiquette to foster productive relationships in a professional environment.

CO3: Successfully plan, create, and deliver presentations that incorporate technology and effectively engage the audience.

CO4: Produce a professional resume and effectively prepare for and participate in job interviews, demonstrating strategies for successful outcomes.

Unit I

Professional Communication in a Digital, Social, Mobile World- Understanding Why Communication Matters, communicating as a Professional, Exploring the Communication Process, Using Technology to Improve Communication.

Unit II

Collaboration, Interpersonal Communication, and Business Etiquette - Communicating Effectively in Teams, Making Meetings More Productive, Improving Listening Skills, Improving Nonverbal Communication Skills, Developing Business Etiquette, Drafting effective Emails.

Unit III

Developing Presentation- Planning a presentation, crafting presentation content, Delivering a presentation, Incorporating Technology in presentations.

Unit IV

Planning and Preparing Resume, Understanding the Interviewing Process, preparing for a Job Interview, Group Discussion, Interviewing for Success, Following Up after an Interview.

References:

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

Web link References:

1. Ana Cuic Tankovic, et.al., Measuring the importance of communication skills in tourism, 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:

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	1	1	2	1	1	3	1	1
CO 2	1	2	3	1	1	1	1	2	1	1
CO 3	1	1	2	1	3	1	1	3	1	1
CO 4	1	2	2	1	1	1	1	3	1	1
Weighted Average	1.25	1.25	2	1	1.75	1	1	2.75	1	1

HC MACHINE LEARNING WITH PYTHON 3:0:1

Total: 45 hours

Objectives:

- Understanding the importance of Machine Learning. and demonstrate the use of data frames in Python.
- Analyze the process of model building and evaluation.
- Comprehend various classification problems.
- Discuss the libraries required to implement the techniques of Machine Learning.

Course Outcomes:

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

CO1: Identify the need for Machine Learning using Python, appropriate data frames and its operations.

CO2: Build and validate linear regression models

CO3: Understand different classification techniques and build classification models.

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, 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

HC ADVANCED COMPUTER NETWORKS 3:1:0

Total: 40 hours

Objectives:

- To understand fundaments of Network topologies, hardware and software.
- To teach the applications and services of Transport.
- To impart the structural mechanism of TCP/IP.
- To create the awareness on the concepts of IP Security.

Course Outcomes:

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

CO1: To employ the mechanism of Network topology, Reference models and TCP/IP.

CO2: To understand the role of Transport Layer in computer networks.

CO3: Employ the techniques of TCP/IP.

CO4: Comprehend the internal working mechanism of IP Security.

Unit I: Introduction

Uses of Computer Network, Topology & Types of Topologies, types of networks (LAN, MAN, WAN), Concept of Intranet, Types of Communications (Asynchronous and Synchronous), Modes of Communications (simplex, half duplex, full duplex), Networking models, ISO-OSI Reference Model, Design issues of the layers, Internet Model (TCP/IP), 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. Computer Networks, Andrew S Tanenbaum, David. J. Wetherall, Pearson Education.
2. High Performance TCP/IP: Networking Concepts, Issues, and Solutions, Mahbub Hassanand Raj Jain, IST Edition, PHI Learning.
3. Network Security Essentials: Applications and Standards, William Stallings, 4th Edition,Prentice Hall

Weblink References:

1. Cooperative Game-Based Resource Allocation Scheme for Heterogeneous Networks with eICIC Technology, Sungwook Kim, Hindawi Journal of Computer Networks and Communications Volume 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)
   Hailu Gizachew Yirga, 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, Biswajit Kumar Dash, Jun Peng, Hindawi Mathematical Problems in Engineering
   https://www.hindawi.com/journals/jcnc/2022/2144702/

4. https://www.pearsonhighered.com/assets/samplechapter/0/7/8/9/0789732548.pdf

Course articulation matrix:

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

HC WEB TECHNOLOGIES 3:0:1

Total: 45 hours

Objectives:

- To help students understand the basis of Internet and how communication happens over the World Wide Web.
- To help students understand the basic building blocks of web pages using HTML and CSS.
- To help students understand and use Java script and the Document Object Model.
- To help students understand PHP web database programming, XML data handling, and JSON framework integration effectively.

Course outcomes:

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

CO1: Develop an ability to implement HTML5 pages using fundamental tags.

CO2: Able to develop style sheet using CSS for a given problem.

CO3: Able to extend JavaScript to validate a form with event handler for a given problem.

CO4: Understand web database programming, XML storage, and JSON framework utilization.

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

HC MAJOR PROJECT 0:2:6

Total: 50 hours

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: 40 hours

Objectives:

- To understand and identifying the problems where AI is required.
- To compare and contrast different AI techniques.
- To understand the concepts of knowledge Representation.
- To understand the NLP techniques.

Course Outcomes:

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

CO1: Express the modern view of AI and its foundation.
CO2: Illustrate Search Strategies with algorithms and Problems.
CO3: Implement Proportional logic and apply inference rules.
CO4: Apply suitable techniques for NLP and Game Playing.

Unit-I: INTRODUCTION

Introduction to AI, The Foundations of AI, AI Technique -Tic-Tac-Toe. Problem characteristics, Production system characteristics, Production systems: 8-puzzle problem. Intelligent Agents: Agents and Environments, Good Behavior: The conceptof rationality – The nature of Environments, The Structure of Agents.

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 NLP

Overview, Minimax algorithm, Alpha-Beta pruning, Additional Refinements. Classical planning problem, Natural Language Processing: Language Models, Text classification, Information Retrieval, Information Extraction.

References:

1. Artificial Intelligence, E. Rich and K. Knight, 3rd Edition, TMH.
2. Artificial Intelligence A Modern Approach, S. Russell and P. Norvig, 3rd Edition, Pearson Education.
3. Introduction to Artificial Intelligence, Eugene Charniak and Drew McDermott, 2nd Edition, Pearson Education.
4. Artificial Intelligence Structures and Strategies for Complex

ProblemSolving, George FLuger, 4th Edition, Pearson Education.
5. Artificial Intelligence: A New Synthesis, N.L. Nilsson, Morgan Kaufmann.

Weblink References:

1. https://www.ijrti.org/papers/IJRTI2304061.pdf
2. https://www.ijraset.com/research-paper/artificial-intelligence
3. https://www.researchgate.net/publication/353118298_Artificial_intelligence_in_information_systems_research_A_systematic_literature_review_and_research_agenda

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: 45 hours

Objectives:

- Gain an in-depth understanding of the relational data model and advanced SQL operations.
- Learn and implement advanced normalization techniques to design relational databases.
- Understand the principles and technologies behind Big Data and NOSQL databases
- Learn about the various methods and challenges associated with securing databases.

Course outcomes:

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

CO1: Demonstrate the ability to design, query, and manage relational databases using SQL.

CO2: Apply normalization techniques to organize data in relational databases, reducing redundancy and improving data integrity.

CO3: Utilize Big Data tools and NOSQL databases to manage and analyze large datasets, demonstrating familiarity with Hadoop, MongoDB.

CO4: Implement and manage security protocols in database environments, addressing potential threats and ensuring data protection.

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: Big Data Technologies and NOSQL Databases

Big Data Technologies Based on MapReduce and Hadoop, What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS) MapReduce: Additional Details.

NOSQL Databases and Big Data Storage Systems, Introduction to NOSQL

Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems NOSQL Graph Databases and Neo4j.

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, Sham kant B. Navathe, 7e.

Reference Books:

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	3	2	2	3	1	1	1	2	3
CO2	3	3	2	2	3	1	1	-	3	2
CO3	3	3	3	2	3	1	1	-	2	2
CO4	2	3	3	3	2	3	1	1	3	2
Weighted Average	2.75	3	2.5	2.25	2.75	1.5	1	1	2.5	2.25

SC CLOUD SECURITY AND PRIVACY 4:0:0

Total: 40 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 of cloud computing, identify different cloud service delivery and deployment models, and discuss the primary drivers and barriers to cloud adoption in enterprises.

CO2: Assess and implement data security measures in cloud environments, manage security incidents, and understand the distribution of security responsibilities between CSPs and customers.

CO3: Identify privacy risks associated with cloud services, apply privacy protection strategies, and understand how different cloud service providers address privacy and compliance issues.

CO4: Evaluate and implement advanced cloud security services, recognize potential threats associated with CSPs, and anticipate future developments in cloud security.

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, 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, 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, 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: 40 hours

Objectives:

- Understand the fundamentals of network security, including threats, Vulnerabilities, and attacks.
- Learn about DES.
- Study the importance of RSA.
- Recognize emerging trends and challenges in network security.

Course outcomes:

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

CO1: Understand the Fundamental Concepts and Principles of Network Security, including Threats, Vulnerabilities, and Defense Mechanisms.

CO2: Analyze network security requirements and design appropriate security Architectures and policies.

CO3: Understand the Applications of Cryptographic Hash Functions.

CO4: Evaluate and assess network security risks and vulnerabilities in the Cloud.

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	3	-	3	-	-	-	-	3	-	3
CO2	3	-	3	-	-	-	-	-	-	3
CO3	3	3	3	-	-	-	-	-	-	3
CO4	3	-	3	3	-	-	3	3	-	3
Weighted Average	3	3	3	3	-	-	3	3	-	3

SC BIG DATA ANALYTICS 3:0:1

Total: 45 hours

Course Objectives:

- Introduce the students to Hadoop and concepts of Map Reduce.
- To understand the concepts of MongoDB
- To impart knowledge on statistical analysis of data
- To understand data Analysis using R.

Course Outcomes:

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

CO1: Process Data with Hadoop.

CO2: Demonstrate Mongodb for flexible storage and retrieval of diverse data

CO3: Comprehend the methods of statistical analysis of data.

CO4: Demonstrate Data Analysis using R.

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 Shrading.

Unit III : Statistical Ananlysis of data

Types of data for statistical analysis, Basic statistical measures, nominal distribution, Correlation analysis, Regresion 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.

Textbooks:

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

Reference:

1. 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	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 THEORY OF LANGUAGES 3:1:0

Total: 40 hours

Objectives:

- Introduce concepts in automata theory and theory of computation.
- Identify different formal language classes and their relationships.
- Design grammars and recognizers for different formal languages.
- Prove or disprove theorems in automata theory using its properties.

Course outcomes:

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

CO1: Demonstrate a fundamental understanding of core concepts in automata theory and formal languages.

CO2: Design and Construct grammars and automata (recognizers) for various classes of languages.

CO3: Analyze different formal language classes and evaluate language membership properties.

CO4: Prove and disprove theorems establishing key properties of formal languages and automata.

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 Ullman,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: 40 hours

Objectives:

- Extend and formalize knowledge of the theory of probability and random variables.
- Introduce new techniques for carrying out probability calculations and identifying probability distributions.
- Understand the concepts and techniques in Mathematical Expectation.
- Understand the Statistical hypotheses and its significance.

Course Outcomes:

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

CO1: Apply axioms and theorems to describe events and compute probabilities also Identify the types of random variables and calculate relevant probabilities.

CO2: Analyse the different Techniques in Continuous Probability Distribution.

CO3: Describe an appropriate statistical model for the given data and compute Population parameters using appropriate estimators.

CO4: Describe the Tests of Hypotheses, Types of errors, test for Significance, regression and curve fitting.

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 Guptaand VK Kapoor.
2. Fundamentals of Statistics- SC Gupta.
3. Probability and Statistics with Reliability,Queuing and Computer Applications-JusgirS Trivedi, Prentice Hall of India.
4. Probability, Random Variables and Stochastic Processes-PapoulisandS. Unnikrishna Pillai, Mc Graw Hill,4th Edition.
5. 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: 40 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: Understand IoT fundamentals, design, enabling technologies, and key communication protocols.".

CO2: Understand IoT architecture, smart objects, and sensor networks for connectivity.

CO3: Design IoT platforms through systematic methodology and comprehensive application development.

CO4: Apply IoT solutions to enhance efficiency across diverse application domains.

Unit 1

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

Unit 2:

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 3:

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 4

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 andProtocols,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 Education 4.0 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: 45 hours

Objectives:

- Learn to build simple android applications.
- Get an understanding of essentials of application design and user interface design.
- Understand different android APIs used to store and manage the data through SQLite.
- Understanding different android networking and web APIs to share the data between the applications.

Course Outcomes:

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

CO1: Build sample android application.

CO2: Develop user interfaces for android applications.

CO3: Develop android applications to share data between different applications.

CO4: Deploy android applications.

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.

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

SC DATA INDEXING TECHNIQUES 3:0:1

Total: 45 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: Understand the fundamental concepts and principles of data indexing using ADT.

CO2: Understanding Priority queue using heap and its applications.

CO3: Implement different data indexing structures such as Binary tree, Binary search tree, AVL and B+ tree

CO4: Evaluate the performance and efficiency of various indexing techniques using hashing

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. Rivest, 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	2	3	3	2	-	-	-	-	-	-
CO2	1	2	3	1	-	-	-	-	-	-
CO3	1	2	3	2	2	-	-	-	-	1
CO4	1	2	3	2	2	-	-	-	-	1
Weighted Average	1.25	2.25	3	1.75	2	-	-	-	-	1

SC INFORMATION RETRIEVAL 3:0:1

Total: 45 hours

Objectives:

- Understand Fundamental Information Retrieval Concepts
- Explore Scoring and Ranking Techniques.
- 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

SC DIGITAL FORENSICS 3:1:0

Total: 40 hours

Objectives:

- To learn about the Cyber Crime and to Understand the concepts of open source tools
- To learn about Cyber Forensics and to identify and report the forensic on disk level
- To learn about Cyber Investigation and to Implement forensic concepts in network level
- To learn about Evidence Management and to Analyze Virtual machine forensic.

Course Outcomes:

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

CO1: Outline the Cybercrime and its types and understand the concepts of various levels of forensics

CO2: Explore the Cyber Forensics Techniques and remembering the concepts of disk forensics.

CO3: Use the Cyber Investigation Techniques and Implement the concepts of Forensics in network.

CO4: Explore the Cyber Evidence Management Techniques and understand the concepts of forensics in devices.

UNIT I CYBER CRIME

Cyber Space – Cyber Crime – Criminal Behaviour – Jurisdictional Concerns - Jurisprudential Inconsistency– eCash Security – Prepaid Cards – Stored Values Cards – Mobile Payments – Internet Payment Services - Cyber stalking - Cyber extortion – Cyber terrorism - Cyber warfare –Cyber weapons -ATM frauds – Phreaking – Internet Gambling.

UNIT II CYBER FORENSICS

Hard disk –Disk characteristics - Disk imaging - Data Carving – Techniques - commercial piracy - soft liftin – Steganography – Network components - Port scans - Wireshark - pcap analysis - 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 audit logs - Investigating Web attacks -Investigating Computer Intrusions - Profiling – Cyber Criminal profiling – Stylometric Techniques – Warranted searches – Warrantless searches – Undercover Techniques.

UNIT IV EVIDENCE MANAGEMENT

Evidence – Digital Evidence - Types – physical evidence – Real evidence – Circumstantial evidence – network evidence - Evidence collection – Evidence Analysis - Contextual Information –Evidence Management – pre search activities – On Scene activities – Report Preparations.

Text Books:

1. Marjie T. Britz, "Computer Forensics and Cyber Crime", Pearson, 2013.
2. Garima Tiwari, "Understanding Laws– Cyber Laws and Cyber Crimes", Lexis Nexis, 2014.
3. Chuck Easttom, Jeff Taylor, "Computer Crime, Investigation, and the Law", Course Technology, 2018.

Reference:

1. Eoghan Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", Eoghan Casey, 2018.

Weblink References:

1. New Approaches to the Application of Digital Forensics in Cybersecurity: A Proposal, Kenneth Okereafor , Rania Djehaiche, https://www.researchgate.net/profile/Kenneth-kereafor/publication/341279338_New_Approaches_to_the_Application_of_Digital_Forensics_in_Cybersecurity_A_Proposal/links/5eb7fd1c299bf1287f782c45/New-Approaches-to-the-Application-of-Digital-Forensics-in-Cybersecurity-A-Proposal.pdf
2. A Review of Application Challenges of Digital Forensics, https://pdfs.semanticscholar.org/e659/24a8f67a86c310e059205ca9370c3b780b18.pdf
3. Next-Generation Digital Forensic Readiness BYOD Framework, Md Iman Ali, Sukhkirandeep Kaur, https://onlinelibrary.wiley.com/doi/full/10.1155/2021/6664426

Course Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1	2	-	2	-	2	-	1	1	-
CO2	1	2	-	2	-	3	-	1	1	-
CO3	1	2	-	2	2	3	-	1	1	-
CO4	1	2	-	2	1	3	-	1	1	-
Weighted Average	1	2	0	2	0.75	2.75	0	1	1	0

SC DIGITAL IMAGE PROCESSING 3:0:1

Total: 45 hours

Objectives:

- Understand the fundamentals of digital image processing.
- Learn the different Image enhancement techniques.
- Understand the image enhancement and segmentation techniques.
- To teach techniques for image segmentation and boundary detection.

Course Outcomes:

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

CO1: Understand the basic concepts of digital image processing.

CO2: Acquire various techniques employed for the enhancement of images using spatial domain

CO3: Learn different techniques employed for the enhancement of images using frequency domain.

CO4: Deploy various techniques of image segmentation.

Unit I:

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, Components of Image Processing System, Elements of Visual Perception, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Unit II:

Image Enhancement in the Spatial Domain Some Basic Gray Level Transformations, Histogram Processing, Enhancement using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Unit III:

Image Enhancement in the Frequency Domain Introduction to the Fourier Transform and the Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering.

Unit IV:

Image Segmentation Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-based Segmentation, Segmentation by Morphological Watersheds.

Textbook:

1. Digital Image Processing – Rafel C. Gonzalez and Richard E. Woods, 2 nd Edition, Pearson Education.

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 EngineeringVolume 2022, Article ID 1574024, 14 pages, https://onlinelibrary.wiley.com/doi/epdf/10.1155/2022/1574024
3. Digital Image Forgery Detection Using JPEG Features and Local Noise Discrepancies, Bo Liu, Chi-Man Pun, Xiao-Chen YuanHindawi Publishing Corporation e Scientific World JournalVolume 2014, Article ID 230425, 12 pages, https://onlinelibrary.wiley.com/doi/epdf/10.1155/2014/230425

Course articulation matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	-	1	-	2	-	-	-	1	-
CO2	3	-	-	1	3	-	-	-	2	-
CO3	3	1	-	1	3	1	-	-	2	-
CO4	3	1	-	-	3	-	-	-	2	-
Weighted Average	3	0.5	0.25	0.5	2.75	0.25	-	-	1.75	-

SC ADVANCED JAVA 3:0:1

Total: 45 hours

Objectives:

- Define JDBC and describe the various JDBC drivers.
- List the advantages and explain the life cycle of a servlet.
- Understand various types of properties in Java beans.
- To know the applications of Java Server Pages.

Course Outcomes:

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

CO1: Develop component-based Java software using JavaBeans.
CO2: Develop server-side programs in the form of servlets.
CO3: Implement Entity Java bean in stateless and stateful environment.
CO4: Employ the concepts of EJB and JAR files.

Unit I: J2EE overview and JDBC

The ABC of Programming Languages, Taking Programming Languages up a notch, Distributive Systems – Real Time Transmissions, Software objects, Web services, The Tier Clients, Resources and Components, J2EE Multi – Tier Architecture, Client tier implementation, Enterprise Application Strategy, A new Strategy, The Enterprise Application.

Unit II: Servlets

Introduction, Life cycle of servlet, A simple Java servlet, Anatomy of Java servlet – Deployment Descriptor, Reading Data from a client, Reading HTTP Request Headers, Sending Data to a client and writing the HTTP Response Header, Cookies and Tracking Sessions.

Unit III: Java Server Pages

Introduction, JSP tags – Variables and Objects, Methods, Control statements, Loops, Tomcat, Request String, User Sessions, Cookies, Session objects.

Unit IV: Enterprise JavaBeans

Introduction, EJB containers, classes and interfaces, Deployment Descriptors – Anatomy, Environment Elements, Referencing EJB and other resources, query element; Session Java Bean- Stateless and stateful, creating a session java bean; Entity Java Bean – Container Managed Persistence, Bean Managed Persistence; The JAR File.

References:

1. The Complete Reference J2EE, Jim Keogh, 1st edition, McGraw Hill Education.
2. Core and Advanced Java, Black Book, Dreamtech Press.

Weblink References:

1. Author: Martinez, D., Remegio, A., Lincopinis,
Title: A review on Java Programming Language
Link: https://www.researchgate.net/publication/371166744_A_Review_on_Java_Programming_Language Year: 2023

2. Author: Ankur Gupta
Title: Comparison in Java and Python: A Review Paper
Link: https://www.ijircst.org/DOC/13-comparison-in-java-and-python-a-review-paper.pdf

3. Title: APPLICATION OF JAVA TECHNOLOGY IN INDUSTRIAL REAL TIME SYSTEM.
https://www.researchgate.net/publication/344839581_Application_of_Java_Technology_in_Industrial_Real-time_Systems

Course articulation matrix:

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

SC WIRELESS SENSOR NETWORKS 3:1:0

Total: 40 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 **DATA MINING** **3:1:0**

Total: 40 hours

Objectives:

- Understand the fundamental concepts, methods, and applications of data mining.
- Analyze the rules and techniques related to association analysis, classification, and clustering, and how they are applied to real-world data.
- Evaluate and compare different classification and clustering algorithms, identifying their strengths and limitations in various contexts.
- Apply data mining techniques to solve practical problems, recognizing the type of data and the appropriate preprocessing needed.

Course outcomes:

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

CO1: Identify and categorize data mining problems, demonstrating the ability to recognize types of data and the necessary pre processing techniques.

CO2: Apply the concepts of association analysis to discover meaningful patterns within datasets.

CO3: Analyze problems suitable for classification and implement different classification algorithms.

CO4: Analyze and apply clustering algorithms to appropriate problems.

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, Evaluation of Association Patterns.

Unit III:

Classification: Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbour Classifiers, Bayesian Classifiers.

Unit IV:

Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph Based Clustering, Scalable Clustering Algorithms.

Textbook:

1. Introduction to Data Mining**,** Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, Pearson, 2e**.**

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	2	3	3	3	2	2	1	1	2	2
CO2	3	3	3	3	2	2	-	-	2	2
CO3	3	3	3	3	3	2	-	-	2	2
CO4	3	3	3	3	3	2	-	-	2	2
Weighted Average	2.75	3	3	3	2.5	2	1	1	2	2

SC ENTREPRENEURSHIP DEVELOPMENT 3:1:0

Total: 40 hours

Objectives:

- To know the fundaments of entrepreneurship.
- To learn importance of women and rural entrepreneurship.
- To understand different motivating factors for entrepreneurs.
- To know essence and characteristics of management.

Course Outcomes:

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

CO1: Analyze the history and need for entrepreneurship.

CO2: Employ the functions of women and rural entrepreneurship.

CO3: Inculcating the behaviors of entrepreneurs.

CO4: Comprehend the need and importance of management.

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.ChandPublication.
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. VARUNA AGARWALA, et. al., FEMALE ENTREPRENEURSHIP, EMPLOYABILITY AND EMPOWERMENT: IMPACT OF THE MUDRA LOAN SCHEME, Journal of Developmental Entrepreneurship, Vol.27, No. 01, 2250005, 2022.
https://www.worldscientific.com/doi/10.1142/S1084946722500054

2. Minh Pham, et. al., The impact of entrepreneurship knowledge on students' e-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: 40 hours

Objectives:

- Understand the basics of Business Intelligence and its evolution.
- Know the concepts of querying, reporting and OLAP architecture.
- Learn about the Business Intelligence lifecycle and its methodologies.
- 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: Acquire the knowledge on Business Intelligence methodologies.

CO2: Comprehend the User models of Business Intelligence in real time scenarios.

CO3: Employ the lifecycle strategies on various BI capabilities.

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, Strategic versus tactical business intelligence, Power versus usability in BI tools, Reporting versus predictive analytics.

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: The OLAP Cube, OLAP access tools. OLAP versus OLTP.

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), Assessing your business infrastructure, Assessing the technology stack, top to bottom, Keep the good stuff, Throw out the bad stuff.

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, RameshShardha. 10thedition, 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-and-advantages-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 PROFESSIONAL ETHICS AND HUMAN VALUES 3:1:0

Total: 40 hours

Objectives:

- Understand the fundamentals of Human values.
- Know the concepts of engineering ethics and responsibilities.
- Get an overview of Global issues and its practices.
- Develop a comprehensive understanding of SEL principles, frameworks, and implementation strategies.

Course outcomes:

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

CO1: Implement the aspects of Human Values.

CO2: Provide depth knowledge on framing of the problem and determining the facts.

CO3: Display the awareness of Global issues in Ethics.

CO4: Understand and implement SEL frameworks to enhance emotional intelligence.

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: Global Issues

Globalization, Environmental ethics: Disaster, Computer ethics: Types of users, computer crimes, Weapons development, Engineers as managers: Charactersitics, Engineers as advisors in planning and policy making, code of ethics::Institute Of Engineering (India).

Unit IV: Social Emotional Learning: Defining social emotional learning, CASEL's SEL Framework, Avoiding the Pitfalls of SEL and Delivering on Its Promise, Three-Step Process for Developing a Common Vision. Introduction to Emotional Intelligence EI, EQ, and SEL: What's the Difference?

References:

1. A Textbook on Professional Ethics and Human Values - R. S. Naagarazan, New Age international publishers.
2. Black, Donna Lord (2022). Essentials of Social and Emotional Learning (SEL).

NJ: Wiley.

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. Chinese Investment Scandal Highlights 'Shadow Banking' Risks
   https://www.nytimes.com/2017/04/19/business/china-minsheng- shadow-banking.html?_ga=2.52299241.1740380992.1515321693-1587685369.1515321693

Course Articulation Matrix

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

SC CYBER SECURITY 3:1:0

Total: 40 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.
- Impart the various topics relating to Computer Forensics.

Course Outcomes:

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

CO1: Understand the concept of cybercrime and offenses.
CO2: Analyze the problems relating to cyber-crimes using mobile phones.
CO3: Demonstrate the various attacks of cyber-crime.
CO4: Understand and apply Computer Forensics at problem areas.

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, Phishing, 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: Computer Forensics

Introduction, Historical background of cyber forensics, Digital forensics science, the need for computer forensics, cyber forensics and digital evidence, forensics analysis of email, digital forensics life cycle, Computer forensics and steganography, Forensics and social networking: The security/privacy threats, Challenges in

computer forensics.

References:

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

Weblink References:

1. Cyberattacks, cyber threats, and attitudes toward cybersecurity policies Keren L G Snider, Ryan Shandler,
   Shay Zandani, Daphna Canetti Journal of Cybersecurity, Volume 7, Issue 1, 2021
   https://doi.org/10.1093/cybsec/tyab019
   https://academic.oup.com/cybersecurity/article/7/1/tyab019/6382745?searchresult=1

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
   https://doi.org/10.32604/jcs.2023.045422
   https://www.techscience.com/JCS/v5n1/54443

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: 40 hours

Objectives:

- To make students understand the basic principles of Simulation, systemcomponents and its applications.
- To learn Properties of Random numbers, algorithms to generate Randomnumbers and Tests for Random numbers. .
- To understand different methods for random Variant generation.
- To learn 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 Randomnumbers and test for Random numbers.

CO3: Implement different methods of generating the Random Variants.

CO4: Analyze the different techniques in Verification and Validation of simulationmodels 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 ADVANCED SOFTWARE ENGINEERING 3:1:0

Total: 40 hours

Objectives:

- Understand the importance of domain knowledge and its work around.
- Know the importance team work and stewardship.
- Analyze and implement solutions to complex problems involving computers.
- A solid understanding to the methods of Software Quality Assurance.

Course Outcomes:

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

CO1: Gain an understanding to work in one or more significant application domains.

CO2: Develop an ability to work as an individual and as part of a multidisciplinary team to develop and deliver quality software.

CO3: Demonstrate an understanding of and apply the current theories, models, and techniques that provide a basis for the software lifecycle.

CO4: Demonstrate an ability to ensure Software Quality Assurance.

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)

4. 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)

5. 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: 40 hours

Objectives:

- To give an overview of the research methodology and explain the technique ofdefining a research problem.
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical andconceptual frameworks and writing a review.
- To explain various research designs and their characteristics.

Course Outcomes:

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

CO1: Identify the suitable research methods and articulate the research steps in a properway.

CO2: Explain the functions of the literature review in research, carrying out a literatureresearch.

CO3: Explain various research designs, sampling designs, measurement and scalingtechniques.

CO4: Perform the data collection from various sources segregate the primary andsecondary.

UNIT I:

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: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledgebase in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

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, Case Study Method. Interpretation: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of report writing, Different steps in writing report, Layout of the research report.

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 2)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 SagePublications, 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

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 WORLD WIDE WEB 3:1:0

Total: 40 hours

Objectives:

- To provide the conceptual and technological development in the field ofInternet and web designing.
- To provide a comprehensive knowledge of Internet, its applications and the TCP/IP protocols widely deployed to provide Internet connectivity worldwide.
- To understand how the World Wide Web with its widespread usefulnesshas become an integral part of the Internet.
- To provide an overview of basic concepts of web design.

Course Outcomes:

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

CO1: Understand the working scheme of the Internet and World Wide Web.

CO2: Evaluate the various protocols of the Internet.

CO3: Comprehend and demonstrate the application of Hypertext Mark-up Language (HTML).

CO4: Apply the various security tools and understand the need of security measures.

Unit I

Introduction to Internet, Evolution and History of Internet, Growth of Internet, Internet Services, How Internet Works, Anatomy of Internet, Internet addressing, Internet vs. Intranet, and Impact of Internet.

Unit II

Internet Technology and Protocol: ISO-OSI Reference Model, Data Transmission, Switching, Routers, Gateways, and Network Protocols

Internet Connectivity: Different types of connections, Levels of Internet Connectivityand Internet Service Provider.

Unit III

Web Page Design-HTML: An Introduction, HTML Categories, HTML Fonts, HTML colors, HTML Lists, HTML Tables, HTML Links, HTML Forms, Adding Pictures and Image Attributes.

Unit IV

Computer Networks, Internet & Web Security: Computer Networks, Network Components, Network Topologies, Types of Network Architecture, Network Security, Firewall, Digital Signature, Authentication, Authorization , Copyright issues and Virus.

References:

1. Internet Technology and Web Design by Instructional Software Researchand Development (ISRD) Group, Tata MC Graw Hill.
2. Programming the World Wide Web, 4th Edition by Robert W. Sebesta.

Weblink References:

1. https://en.wikipedia.org/wiki/World_Wide_Web
2. https://www.geeksforgeeks.org/world-wide-web-www/
3. https://onlinecourses.swayam2.ac.in/nou22_cs03/preview
4. https://link.springer.com/article/10.1007/s11280-024-01284-1

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	1	1	1	-	-	1	1	1	1
CO 2	2	1	1	1	-	-	1	1	1	1
CO 3	2	1	1	1	1	-	1	1	1	1
CO 4	2	2	2	1	1	1	1	1	1	1
Weighted Average	2	1.25	1.25	1	0.5	1	1	1	1	1

OE E-COMMERCE 3:1:0

Total: 40 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, SunitBelapure 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: 40 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 systematicliterature 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 by Elsevier, 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 inAcademic 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, InternationalJournal 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. VenkataKrishna 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, MuhammadHabib ur Rehman, Ibrar Yaqoo, Khaled Salah, Muhammad Imran, PremPrakash Jayaraman, Charith Perera, https://www.sciencedirect.com/science/article/pii/S0167739X18313645

Machine Learning

1. Computer generated images vs. digital photographs: A synergetic feature andclassifier combination approach, Eric Tokuda, Helio Pedrini and AndersonRocha, 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, HOLISTICAVol 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 - 2024

Sl. No.	Category	Name	Designation	Address for Communication	E-mail and Mobile No.
1	Chairperson	Mrs. Rachana C R	Associate Professor & Head	Department of Studies in Computer Science, PG Wing of S.B.R.R. Mahajana First Grade College (Autonomous), Pooja Bhagavat Memorial Mahajana Education Centre, K.R.S. Road, Metagalli, Mysuru-570016.	rachanacr@gmail.com 8095645644
2	Faculty of the Department	Smt. Yashaswini J	Assistant Professor		yashuj.krn@gmail.com 9538779281
3		Dr. Anisha Kumar			anishakumar2010@gmail.com 9483468829
4		Ms. Likhitha M M			likhithamm@gmail.com 7022444565
5		Mrs. Eswin Angel Pria			eswin.mtech@gmail.com 7338527687
6		Ms. Sushmita Sheeba Dsa			sushmitadsa24@gmail.com 8867982521
7		Mrs. Meghana J			meghanajgowda1984@gmail.com 8123153878
8	University Nominee	Prof. Suresha	Professor	DoS in Computer Science, University of Mysore, Manasagangothri, Mysuru.	sureshasuvi@gmail.com 9449810894
9	Two Experts from other university	Dr. R.K. Bharathi	Professor & Head	Department of Computer Applications, J.S.S Science & Technology University, Mysore.	rkbharathi@jssstuniv.in 9481150296
10		Dr. Siddesha S	Associate Professor		siddesh.shiv@jssstuniv.in 8884885076
11	Alumnus	Mr. Vinayaka Hegde	Senior Application Engineer	Oracle Tech Hub Block B & C No.169/1, BBMP Ward No.150-Bellandur, Sarjapur Marathahalli Ring Road, Kadubeesanahalli, Varthur Hobli, Bengaluru.	hegdevinayaka171@gmail.com 9481111860
12	Industry Expert	Mr. Harsha Srinivas	Director	AIMLWare Systems Private Limited IC-3, 1st Floor, SJCE-STEP SEED building, JSS Technical Institution campus, Manasagangotri, Mysuru-570006	harsha@aimlware.com 8904831200