# School of Engineering & Technology

# Department of Computer Science and Engineering

# M.Sc. –Computer Science

## With Specialisation in Artificial Intelligence

Semester I, II , III & IV

**AY 2023-2025**

## Semester I

| Theory/ Practical | Sl. No | Course Type | Course Code | Course Name | Hours per week | | | Credit | Mark | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | C | CA | FA |
| T | 1. | DSCC | | Computational Techniques using Python | 3 | 0 | 0 | 3 | 40 | 60 |
| T | 2. | DSCC | | Advanced Data Structures & Algorithms | 3 | 0 | 0 | 3 | 40 | 60 |
| T | 3. | OEC | | Artificial Intelligence | 3 | 1 | 0 | 4 | 40 | 60 |
| T | 4. | DSCC | | Mathematical and Statistical Foundations | 3 | 0 | 0 | 3 | 40 | 60 |
| T | 5. | AEC | | Personality and Soft Skill development | 3 | 0 | 0 | 3 | 50 | 50 |
| P | 6. | DSCC | | Advanced Data Structures & Algorithms LAB | 0 | 0 | 4 | 2 | 50 | 50 |
| P | 7 | DSCC | | Web Technology Lab | 0 | 0 | 4 | 2 | 50 | 50 |
| | | | | **Total** | **15** | **1** | **8** | **20** | **310** | 390 |

## Semester II

| Theory/ Practical | Sl. No | Course Type | Course Code | Course Name | Hours per week | | | Credit | Mark | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | C | CA | FA |
| T | 1. | **DSCC** | | Computer Organization and architecture | **3** | **0** | **0** | **3** | 40 | 60 |
| P | 2. | **DSCC** | | Advanced Database management system | **3** | **0** | **0** | **3** | 40 | 60 |
| T | 3. | **DSCC** | | Software Engineering | **3** | **0** | **0** | **3** | 40 | 60 |
| T | 4. | **OEC** | | Image Processing/ Speech & Natural Language Processing | **3** | **1** | **0** | **4** | 40 | 60 |
| T | 5. | **DSCC** | | Machine Learning | **3** | **0** | **0** | **3** | 40 | 60 |
| P | 6. | **DSCC** | | Machine Learning Lab | **0** | **0** | **4** | **2** | 50 | 50 |
| T/P | 7. | **DSCC** | | Advanced DBMS Lab ( SQL/ NoSQL) | **0** | **0** | **4** | **2** | 50 | 50 |
| | | | | **Total** | **15** | **1** | **8** | **20** | 300 | 400 |

## Semester III

| Theory/ Practical | Sl. No | Course Type | Course Code | Course Name | Hours per week | | | Credit | Mark | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | C | CA | FA |
| T | 1. | **DSCC** | | Deep Learning | **3** | **0** | **0** | **3** | 40 | 60 |
| P | 2. | **DSCC** | | Operating Systems | **3** | **0** | **0** | **3** | 40 | 60 |
| T | 3. | **DSCC** | | Big Data Analytics / Data Science | **3** | **1** | **0** | **4** | 40 | 60 |
| T | 4. | **OEC** | | Advanced Web Technology | **3** | **0** | **0** | **3** | 40 | 60 |
| T | 5. | **DSCC** | | Deep learning Lab | **0** | **0** | **4** | **2** | 50 | 50 |
| P | 6. | **AEC** | | Minor Project | 0 | 0 | 8 | 4 | 50 | 50 |
| T/P | 7. | **SEC** | | Seminar paper | 0 | 0 | 2 | 1 | 00 | 100 |
| | | | | **Total** | **12** | **1** | **14** | **20** | 260 | 440 |

# Semester IV

| Theory/ Practical | Sl. No | Course Type | Course Code | Course Name | Hours per week | | | Credit | Mark | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | C | CA | FA |
| T | 1. | VAC | | Universal Human Values | 2 | 1 | 0 | 3 | 00 | 100 |
| P | 2. | IC | | Elective-IV ( As per Table)(As per SWAYAM) | 3 | 0 | 0 | 3 | 00 | 100 |
| T | 3. | **DSCC** | | Elective-V ( As per Table)(As per SWAYAM) | 3 | 0 | 0 | 3 | 00 | 100 |
| T | 4. | AEC=7 SEC =7 | | System Development Project | - | - | 22 | 11 | 200 | 200 |
| | | | | **Total** | **8** | **1** | 22 | **20** | 200 | 500 |

## OPEN ELECTIVE COURSES (SPECIALIZATION)

### (MOOCS: SWAYAM COURSES)

| CODE | Elective-I | CODE | Elective-II |
|---|---|---|---|
| | Quantum Computing | | Internet of Things |
| | Molecular Computing | | Computer network and Internet security |
| | Nano Technology | | Wireless Networks |
| | Robotics | | Android Mobile Application Dev |
| | Remote Sensing & GIS | | Database and content organization |

**(or any other Course added time to time)**

**Abbreviations Used:**

DSCC : Discipline Specific Core Courses
AEC : Ability Enhancement Compulsory Course
VAC : Value Addition Courses
OEC : Open Elective Courses
SEC : Skill Enhancement Courses
CE : Continuous Evaluation
ESE : End Semester Examination
L/T/P: Lecture / Tutorial / Practical

# SEMESTER - I

| DSCC | **Computational Techniques using Python** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Prerequisite:** Basic knowledge of Programming

**Course Objectives:**

Students will be able to–

In this course students are introduced to use Python as a tool to solve problems. The emphasis is to learn using a high level programming language without actually going through the logic behind the equations that are to be coded. A minimal understanding of the basic mathematics is assumed. This develops familiarity and equips them to code a large number of real life problems and learn how to obtain results and plots using the software.

**Course Outcome:**

At the end of successful completion of the course, students will be able to

1. Evaluate the python in built functions.
2. Evaluate the various feature engineering algorithms by python programming.
3. Design and apply various algorithms to solve real time complex problems.

**Module1: Introduction to Python Programming** — **8 Hours**

History of Python Programming Language, thrust areas of Python in real-life problem solving applications,

Fundamental programming with Python: Designing a Program, identifiers, keywords, operators, and expressions. Arithmetic, Logical and Assignment operators, Precedence, Data types: Basic data types: Strings and numbers, displaying an output, type conversion, basic string operations& methods, format specifiers

**Module:2 Tuples, Lists & Dictionaries** — **10 Hours**

**Tuples:** immutable sequences, creating tuple, basic tuple operations. Lists: mutable sequences, basic list operations, List methods Dictionaries: basic dictionary operations, dictionary method User input variable.

**Module:3 Control structures** — **12Hours**

**Decision Structures:** If, If —-else, if ….elif…..else, nested if decision flow statements.

**Repetition Structures:** condition controlled: while loop. Count controlled: for loop, sentinals, continue and break statements, try and except statements.

**Module:4 Functions & Files** — **10 Hours**

Built in function, modules, void function, flow charting, hierarchy charts, Local variables and scope, passing an argument function, value returning functions, Random number generation

**Files:** introduction to file input and output.

**Module:5 Scientific computing packages** — **5 Hours**

**Numpy:** -Array object, creating array, matrix, indexing, slicing, resizing, reshaping, arithmetic operations, functions, matrices and vector operations Matplotlib: basic plotting, Scipy: Linear algebra operations, equation solving.

**Total hours** — **45 hours**

| **Text Book** | |
|---|---|
| 1. | Mark Lutz, "Learning Python" O'Reilly Media, 2013. |
| **Reference Books** | |
| 1.<br>2.. | Robert Johansson, "Numerical Python: Scientific Computing and Data Science .Applications with Numpy, SciPy and Matplotlib" Apress, 2019.<br>Rubin H. Landu, Manuel J. Paez, and Cristian C.Bordeianu, "Computational Physics Problem solving with Python" – Third Edition, Wiley VCH, 2015. |

| **DSCC** | **Advanced Data Structures & Algorithms** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Prerequisite:**-- Knowledge of Data Structure

**Course Objectives:**

Students will be able to-

1. To impart knowledge on advanced data structure and algorithms to analyze complexity of algorithms.
2. The fundamental design, analysis, and implementation of basic data structures.
3. Significance of algorithms in the computer field.
5. Various aspects of algorithm development .

**Course Outcome:**

At the end of successful completion of the course , students will be able to-

1. Basic ability to analyze algorithms and to determine algorithm correctness and time efficiency class.
2. Master a variety of advanced abstract data type (ADT) and data structures and their implementations.
3. Master different algorithm design techniques (brute-force, divide and conquer, greedy, etc
4. Ability to apply and implement learned algorithm design techniques and data structures to solve problems.

**Module: 1 Introduction** **8 hours**

Algorithms, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big Oh, Omega and Theta notations, Complexity Analysis Examples. Data structures-Linear and non linear data structures, ADT concept, Linear List ADT, Array representation, Linked representation, Vector representation, singly linked lists -insertion, deletion, search operations, doubly linked lists-insertion, deletion operations, circular lists. Representation of single, two dimensional arrays, Sparse matrices and their representation.

| **Module:2 Hashing** | **7 hours** |
|---|---|
| Hashing – General Idea, Hash Function, Separate Chaining, Hash Tables without linked lists: Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Hash Tables in the Standard Library, Universal Hashing, Extendible Hashing. | |
| **Module:3 Priority Queues (Heaps)** | **6 hours** |
| – Model, Simple implementations, Binary Heap: Structure Property, Heap Order Property, Basic Heap Operations: insert, delete, Percolate down, Other Heap Operations. Binomial Queues: Binomial Queue Structure, Binomial Queue Operations, Implementation of Binomial Queue, Priority Queues in the Standard Library | |
| **Module:4 Trees** | **6 hours** |
| Trees – AVL: Single Rotation, Double Rotation, B-Trees. Multi-way Search Trees – 2-3 Trees: Searching for an Element in a 2-3 Tree, Inserting a New Element in a 2-3 Tree, Deleting an Element from a 2-3 Tree. Red-Black Trees – Properties of red-black trees, Rotations, Insertion, Deletion | |
| **Module:5 Graphs Algorithms** | **7 hours** |
| Elementary Graph Algorithms: Topological sort, Single Source Shortest Path Algorithms: Dijkstra's, Bellman-Ford, All-Pairs Shortest Paths: Floyd-Warshall's Algorithm. | |
| **Module: 6 Disjoint Sets and String Matching** | **7 hours** |
| **Disjoint Sets** – Equivalence relation, Basic Data Structure, Simple Union and Find algorithms, Smart Union and Path compression algorithm.<br><br>**String Matching** – The naive string-matching algorithm, The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm. | |
| **Module: 7 Basic algorithmic techniques** | **7 hours** |
| Greedy algorithms, divide & conquer, dynamic programming. Search techniques - backtracking, Sorting algorithms with analysis, integer sorting, selection sort. Graph algorithms: DFS and BFS with applications, MST and shortest paths. | |
| **Total Lecture hours** | **48 hours** |

**Textbook**

| | |
|---|---|
| 1. | Advanced Data Structures, Reema Thareja, S. Rama Sree, Oxford University Press, 2018 |
| 2. | Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, 4th Edition, 2014, Pearson. |
| 3. | Introduction to Algorithms, Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 3rd Edition, 2009, The MIT Press. |

**Reference Books**

| | |
|---|---|
| 1. | Fundamentals of Computer Algorithms, Ellis Horowitz, SatrajSahani and Rajasekharam, 2nd |

| | |
|---|---|
| | Edition, 2009, University Press Pvt. Ltd. |
| 2. | S. Sahni, Data Structures, Algorithms, and Applications in C++, Silicon Press, 2/e, 2005.<br>2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms,<br>MIT Press, 3/e, 2009. |
| 3. | A. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, Data Structures Using C and C++,<br>Prentice Hall, 2/e, 1995. |


| OEC | **Artificial Intelligence** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **1** | **0** | **4** |

**Prerequisite:** Programming skills, Discrete mathematics, Probability Theory

**Course Objectives:**

Students will be able to–

1. To become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
2. To learn the methods of solving problems using Artificial Intelligence
3. To learn the knowledge representation techniques, reasoning techniques and planning
4. To introduce the concepts of Expert Systems and machine learning.

**Course Outcome:**

At the end of successful completion of the course, students will be able to

1. Demonstrate fundamental understanding of artificial intelligence (AI) and expert systems.
2. Apply basic principles of AI in solutions that require problem solving, reasoning, planning, knowledge representation and uncertainty.
3. Demonstrate proficiency in applying inductive learning.
4. Communicate effectively about AI problems, algorithms, implementations, and their experimental evaluation.

**Module:1 Introduction** — **9 Hours**

Problem Solving- Formulating problems, problem types, states and operators, state space,Scope of AI in: Natural Language Processing, vision and speech processing, expert systems, robotics, games, theorem proving.

**Module:2 Search strategies** — **10 Hours**

Problem solving methods: search strategies, uninformed search and informed search, depth first search, breadth first search, Heuristic search: hill climbing, best first search, tabu search, Randomized search: simulated annealing, genetic algorithm, ant colony optimization, branch and bound, A*, IDA*, divide and conquer approaches, beam stack search, problem reduction, goal trees, AO*, Rule based systems, game playing: minimax algorithm, alpha-beta algorithm, SSS*

| **Module:3 Reasoning** | **10Hours** |
|---|---|
| Knowledge representation: First order predicate knowledge, unification, modus pones, resolutions, dependency directed backtracking, Rule based systems: forward reasoning, conflict resolution, backward reasoning, structured knowledge representation: semantic nets, slots, exception, default frames, conceptual dependency, scripts. | |
| **Module:4 Planning and uncertainty** | **11 Hours** |
| Basic representation of plans, partial order planning, planning in the blocks world, hierarchical planning, conditional planning, probabilistic reasoning, non-monotonic reasoning, fuzzy logic, Basic probability, Bayes rule, Belief networks, Default reasoning, Fuzzy sets and fuzzy logic; Decision making- Utility theory, utility functions, Decision theoretic expert systems,neural nets | |
| **Module:5 Inductive learning** | **10 Hours** |
| Decision trees, rule based learning, currentbest-hypothesis search, least-commitment search , neural networks, reinforcement learning, genetic algorithms; Other learning methods - neural networks, reinforcement learning, genetic algorithms. | |
| **Module:6 Planning and constraint satisfaction** | **10 Hours** |
| Domains, forward and backward search, goal stack planning, plan space planning, graph plan, constraint propagation | |
| **Total Lecture hours** | **60 hours** |

| **Text Book** | |
|---|---|
| 1. | Stuart Russell and Peter Norvig. Artificial Intelligence – A Modern Approach, Pearson Education Press |
| 2. | Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, McGraw Hill |
| **Reference Books** | |
| 1. | George F. Luger, Artificial Intelligence, Pearson Education |
| 2. | Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kauffman |

| **DSCC** | **Mathematical and Statistical Foundations** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |
| **Prerequisite:** Basic Statistics | | | | | |
| **Course Objectives:** | | | | | |

1. The Number Theory basic concepts useful for cryptography etc.

2. The theory of Probability, and probability distributions of single and multiple random variables.

3. The sampling theory and testing of hypothesis and making inferences.

4. Stochastic process and Markov chains.

**Course Outcome:**

Upon completion of this course, the student will be able to

1. Apply the number theory concepts to cryptography domain.

2. Apply the concepts of probability and distributions to some case studies.

3. Correlate the material of one unit to the material in other units.

4. Resolve the potential misconceptions and hazards in each topic of study.

| **Module: 1** | **9 hours** |
|---|---|

**Greatest Common Divisors and Prime Factorization**: Greatest common divisors, The Euclideanalgorithm, The fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers.

**Congruences**: Introduction to congruences, Linear congruences, The Chinese remainder theorem,Systems of linear congruences.

| **Module: 2** | **10 hours** |
|---|---|

**Simple Linear Regression and Correlation**: Introduction to Linear Regression, The Simple LinearRegression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators,Inferences Concerning the Regression Coefficients, Prediction, Simple Linear Regression Case Study.

**Random Variables and Probability Distributions**: Concept of a Random Variable, DiscreteProbability Distributions, Continuous Probability Distributions, Statistical Independence.

**Discrete Probability Distributions**: Binomial Distribution, Poisson distribution.

| **Module: 3** | **10 hours** |
|---|---|

**Continuous Probability Distributions**: Normal Distribution, Areas under the Normal Curve,Applications of the Normal Distribution, Normal Approximation to the Binomial.

**Fundamental Sampling Distributions**: Random Sampling, Sampling Distributions, SamplingDistribution of Means and the Central Limit Theorem, Sampling Distribution of S2, t–Distribution, F-Distribution.

| **Module: 4** | **9 hours** |
|---|---|

**Estimation & Tests of Hypotheses**: Introduction, Statistical Inference, Classical Methods ofEstimation. Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, ToleranceLimits, Estimating the Variance, Estimating a Proportion for single mean, Difference between TwoMeans,

| AEC | **Personality and Soft Skill development** | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

| | |
|---|---|
| between Two Proportions for Two Samples and Maximum Likelihood Estimation. | |
| **Module: 5** | **8 hours** |
| **Stochastic Processes and Markov Chains:** Introduction to Stochastic processes- Markov process.Transition Probability, Transition Probability Matrix, First order and Higher order Markov process,n-step transition probabilities, Markov chain, Steady state condition, Markov analysis. | |
| **Total hours** | **46 hours** |
| **Text Book** | |
| 1. | Kenneth H. Rosen, Elementary number theory & its applications, sixth edition, AddisonWesley, ISBN 978 0-321-50031-1 |
| 2. | Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statisticsfor Engineers & Scientists, 9th Ed. Pearson Publishers. |
| **Reference Books** | |
| 1. | S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications |
| 2. | T.T. Soong, Fundamentals of Probability and Statistics For Engineers, John Wiley & SonsLtd, 2004. |

**Course Outcomes:**

Upon completion of this course, the student will be able to

CO1:Understand the importance ofSoftskills and how to useinourlives
CO2:PerformSWOTanalysis-learningtomaximizesuccess using apersonal SWOT
CO3:DetermineCommunicationstyles-typeswithexamples,perceptionofeachtypeof communication, quiz
CO4:Focusonvariouscommunicationskills/listening/stressmanagementetc.
CO5:Train for Etiquette-socialandcorporate-Types,Presentationskills,Interviewtechniques etc.

**TeachingMethodology:**

Presentations,Groupdiscussions,Brainstorming,CaseStudies,MotivationalVideos,Quizzes,andotherGroupActivities

| Unit | Contentsof the syllabus | Number of Hours |
|---|---|---|
| 1 | ▪ Whataresoftskills<br>▪ Theimportanceofsoft skillsinour lives | 2 |
| 2 | ▪ WhatisPersonality?<br>▪ Personalitytraitsandtipstodevelopa goodPersonality | 2 |
| 3 | ▪ Self-presentation-<br>▪ WhatisSelf-presentation,<br>▪ Strategiesofself-presentation | 2 |
| 4 | ▪ SWOTanalysis<br>▪ Learningto maximize successusingSWOT<br>▪ Howto do a personal SWOT | 4 |
| 5 | ▪ Self-analysis<br>▪ Significanceandmethodsofself-analysis | 2 |
| 6 | ▪ Communicationskills<br>▪ Process,elements,andimportance<br>▪ Waystoimprovecommunication | 2 |
| 7 | ▪ Communicationstyleswithexamples<br>▪ Perceptionofeachtypeofcommunication | 2 |
| 8 | ▪ Assertiveness<br>▪ Whatisassertiveness<br>▪ Importanceintoday's world | 2 |
| 9 | ▪ Non-verbalcommunication andit'stypes<br>▪ Importanceandroleofnonverbalcommunication<br>▪ Waystoimproveournonverbalcommunication | 2 |
| 10 | ▪ AcingTimemanagement<br>▪ Whatistimemanagement<br>▪ Benefitsoftimemanagement<br>▪ Strategiestoimprovetimemanagement | 2 |
| 11 | ▪ Goalsetting<br>▪ Importanceof Goalsetting<br>▪ TypesofGoals,<br>▪ Waystoachievegoals | 2 |
| 12 | ▪ Changemanagement and changecurve<br>▪ Impactofchange<br>▪ Learningtomanagechangein ourlives | 2 |

| | | |
|---|---|---|
| **13** | ▪ StressManagement<br>▪ Whatisstress andit'scauses<br>▪ Techniquesofstressmanagement | **2** |
| **14** | ▪ Listeningskills<br>▪ Importanceandtypes<br>▪ Waystoimprovelisteningskills | **2** |
| **15** | ▪ Team/groupdynamicsandgroupdiscussion<br>▪ Importanceof groupwork<br>▪ Effectivecommunication withinateam | **2** |
| **16** | ▪ Presentationskills<br>▪ Tipstomakeeffectiveandengagingpresentations | **2** |
| **17** | ▪ Etiquette<br>▪ Socialandcorporate-Types<br>▪ Importance andimpactofbusinessandsocialetiquette | **2** |
| **18** | ▪ Interviewtechniques<br>▪ MockInterviews-Dosanddon'ts,FAQ's<br>▪ Tipson makingapositiveimpression | **2** |
| **19** | ▪ Variousactivitieswitha practicalapproachbasedoneverydaylife situations | **7** |
| | **TotalNumberofHours** | **45** |

**SuggestedReferenceBooks**

1. Softskills&Lifeskills:Thedynamicsof success-NishiteshandDr.BhaskaraReddy
2. SoftSkills-Dr.Alex
3. ManagingSoftskills-K.R LakshminarayanandT.Murugavel
4. SoftskillsandProfessionalCommunication-FrancisPeterS.J
5. TheAceofSoft skills-GopalswamyRamesh andMahadevan Ramesh
6. PersonalityDevelopmentandSoftskills-BarunK.Mitra
7. SoftPower: Anintroduction toCore&Corporatesoftskills-Anitha Arunima
8. HowtotalktoAnyone,Anytime,Anywhere-LarryKing

| **DSCC** | **Advanced Data Structures & Algorithms Lab** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **4** | **2** |

**Prerequisite:**-- Knowledge of Data Structure

**Course Objectives:**

Students will be able to-

1. The fundamental design, analysis, and implementation of basic data structures.

2. Basic concepts in the specification and analysis of programs.

3. Principles for good program design, especially the uses of data abstraction.

4. To understand the sorting techniques

5. To understand the non linear data structures 6. to learn bout the pattern matching

**Course Outcome:**

At the end of successful completion of the course , students will be able to-

1. Basic ability to analyze algorithms and to determine algorithm correctness and time Efficiency class.
2. Master a variety of advanced abstract data type (ADT) and data structures and their Implementations.
3. Master different algorithm design techniques (brute-force, divide and conquer, greedy, etc.)
4. Ability to apply and implement learned algorithm design techniques and data structures to solve problems

**Practical Experiments:**

1. Write Java/C/C++ programs that use both recursive and non-recursive functions for

implementing the following searching methods:

a) Linear search b) Binary search

2. Write Java/C/C++ programs to implement the following using arrays and linked lists

a) List ADT

3. Write Java/C/C++ programs to implement the following using an array.

a) Stack ADT b) Queue ADT

4. Write a Java/C/C++ program that reads an infix expression and converts the expression to

postfixform. (Use stack ADT).

5. Write a Java/C/C++ program to implement circular queue ADT using an array.

6. Write a Java/C/C++ program that uses both a stack and a queue to test whether the given string isa palindrome or not.

7. Write Java/C/C++ programs to implement the following using a singly linked list.

a) Stack ADT

b) Queue ADT

8. Write Java/C/C++ programs to implement the deque (double ended queue) ADT using

a) Array b) Singly linked list c) Doubly linked list.

9. Write a Java/C/C++ program to implement priority queue ADT.

10. Write a Java/C/C++ program to perform the following operations:

a) Construct a binary search tree of elements.

b) Search for a key element in the above binary search tree

c) Delete an element from the above binary search tree.

11. Write a Java/C/C++ program to implement all the functions of a dictionary (ADT) using Hashing.

12. Write a Java/C/C++ program to implement Dijkstra's algorithm for Single source shortest path problem.

13. Write Java/C/C++ programs that use recursive and non-recursive functions to traverse the given binary tree in

a) Preorder b) Inorder c) Postorder.

14. Write Java/C/C++ programs for the implementation of bfs and dfs for a given graph.

15. Write Java/C/C++ programs for implementing the following sorting methods:

a) Bubble sort d) Merge sort g) Binary tree sort

b) Insertion sort e) Heap sort

c) Quick sort f) Radix sort

16. Write a Java/C/C++ program to perform the following operations:

a) Insertion into a B-tree b) Searching in a B-tree

17. Write a Java/C/C++ program that implements Kruskal's algorithm to generate minimum costspanning tree.

18. Write a Java/C/C++ program that implements KMP algorithm for pattern matching.

| DSCC | **Web Technology Lab** | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**Prerequisite**: Basic knowledge of Web Programming

**Course Objectives:**

The objective of the course is to train the learners about the tools and techniques of web technology such that the learners can develop we application for a particular system independently not only theoretically but also practically using several we technology tools.

**Course Outcomes**
CO 1: Analyze a web page and identify its elements and attributes.
CO 2: To acquire knowledge of XML fundamentals and usage of xml technology in electronic data interchange
CO 3: Build dynamic web pages using JavaScript (client side programming).
CO 4: To design and develop web based enterprise systems using technologies like jsp, servlet.
CO 5: Build web applications using PHP

| Module | Topic | Course Content | Hours |
|---|---|---|---|
| I | | College Placement Information System Write a PHP/Java/.NET program to connect to a database and retrieve data from a table and show the details in a neat format. | |
| II | | Write a stored procedure in MYSQL and using PHP/Java/.NET code insert or add data into MYSQL table. | |
| III | | A simple calculator web application that takes two numbers and an operator (+, ,/,*and %) from an HTML page and returns the result page with the operation performed on the operands | |
| IV | | Create an application using HTML, JSP and MySQL Database. HTML file will take data from user which will be inserted, Displayed and stored in database by JSP. | |

| | | | |
|---|---|---|---|
| V | | Write PHP program<br>a) To send mail.<br>b) To convert a string, lower to upper case and upper case to lower case or capital case.<br>c) To change image automatically using switch case.<br>d) To calculate current age without using any pre-define function.<br>e) To upload image to the server using html and PHP. | |
| | | Write a code in PHP/Java/.NET to call MYSQL stored procedure with parameters. | |
| | | Write a code in PHP/Java/.NET to execute MYSQL trigger<br>a) before insert of values to the table<br>b) delete and edit of a record | |
| | | Demo project (Choose any one): Optional<br>a) Student Management System.<br>b) Library Management System<br>c) Hospital Management System<br>d) Online Book Store Project in PHP<br>e) Hostel Management<br>f) Online Examination System<br>g) Job portal system<br>h) Event Management System<br>i) Online Pharmacy System | |

**TEXT/REFERENCES BOOK:**

| | |
|---|---|
| 1. | Web Technologies 2nd Edition, Achyut S Godbole & Atul Kahate |
| 2. | Internet and World Wide Web Deitel HM, Deitel ,Goldberg , Third Edition |
| 3. | Murach's PHP and MySQL 2nd Edition, by Joel Murach and Ray Harris, Mike Murach & Associates |

## School of Engineering & Technology
## Department of Computer Science and Engineering
### M.Sc. – Computer Science (With Specialisation in Artificial Intelligence)
### SEMESTER - II

| DSCC | Computer Organization and architecture | L | T | P | C |
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**Prerequisite:NA**

**Course Objectives:**

Students will be able to–

*teach the learners about the design of basic the components of a Computer System . The learners will able to know about the working principle of each device and how they work in the context of a computer system. The learner will also know about I/O and memory concepts of a computer system.*

**Course Outcome:**

At the end of successful completion of the course, students will be able to

1. Understand the basic organizationofcomputer anddifferentinstructionformats andaddressing modes.
2. Analyzetheconceptofpipelining,segmentregistersandpindiagramofCPU.
3. Understandandanalyzevariousissuesrelatedtomemoryhierarchy.
4. EvaluatevariousmodesofdatatransferbetweenCPUandI/Odevices.
5. Examinevariousinterconnectionstructuresofmultiprocessors.

| **Module: 1** | **10 hours** |
|---|---|

Number system and logic gates : Decimal, Octal , Hexadecimal and binary numbers systems and their conversion and arithmetic. Negative and floating point number representation. Boolean algebra and Logic gates : definition of Boolean algebra and its theorems. Truth tables and Boolean functions , reduction Construction of logic circuits from a Boolean function.Combinational and sequential circuits : Adder, Subtractor, Decoder, Encoder, and Multiplexers, ROM.Sequential circuits : SR, D, JK, T flip flops.Introduction to Registers and counters.

| **Module: 2** | **8 hours** |
|---|---|

Instructionformat-operandaddressingformats–three,twooneandzeroaddressinstructions;Instructionsetselection,Instructiontypes:datatransfer,datamanipulationandprogramcontrol;Addressing modes - direct, indirect, immediate, relative, indexed etc. Instruction execution process -fetchandexecutioncycles;datapathorganization–singleandtwobus;controlstructure:hardwiredandmicro-programmed; control steps in different instruction execution, Reduced instruction set computer(RISC), CISC and RISC characteristics, block diagram and pin diagram of 8085, use of registers inassemblylanguageprograms, assemblylanguageprogramming.

| **Module: 3** | **10 hours** |
|---|---|

Reviewofadditionandsubtractionwithsignedmagnitudeand2'scomplementdata,hardwareimplementation,Multiplicationalgorithm,Hardwareimplementation,hardwarealgorithm,Boothsmultiplicationalgorithm, Arraymultiplier, Divisionbasic, Floatingpoint arithmetic.

| **Module: 4** | **8 hours** |
|---|---|

CharacteristicsofsimpleI/Odevices,theircontrollers;I/Ointerface –addressing:memorymappedandisolated I/O, data transfer: Synchronous and Asynchronous data transfer, types of asynchronous datatransfer:strobecontrol,handshaking.Modesofdatatransfer:programcontrolled,interruptinitiatedandDMA data transfer; polled and interrupt controlled synchronization; Interrupt mechanism -deviceidentification-polling,vectored;priorityschemes-daisychaining,interruptmasking;ConceptofDMAcyclestealingandburstmode,DMAinterfacebusarbitrationmechanism;ConceptofI/Ochannelsandperipheralprocessors.

| **Module: 5** | **10 hours** |
|---|---|

Memory hierarchies, Cache memory- Mapping techniques, Virtual memory- address space, memoryspace,address mappingusingpages.

| **Total Lecture hours** | **46 hours** |
|---|---|

**Text Book**

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|---|---|
| 1. | ManoM.M:ComputersystemArchitecture,PHI(EEE) |
| 2. | Hamacher,Vranesicand Zaky:ComputerOrganization,TMGH |

**Reference Books**

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|---|---|
| 1. | WilliamStallings,ComputerOrganizationandarchitecture,Pearson |
| 2. | Stallings:ComputerOrganization&Architecture, PE |
| 3. | Hayes:ComputerArchitecture&Organization,MGH |
| 4. | Hennessey:ComputerArchitecture,Elsevier |

| DSCC | **Advanced Database Management System** | **L** | **T** | **P** | **C** |
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**Prerequisite:**Database Management System

**Course Objectives:**

Students will be able to–

1. To understand the different types of database system architectures.
2. To Design and implement advanced object-oriented database queries using Structured Query Language.
3. To study and design distributed database with its applications
4. To Understand and study parallel database principles.
5. To administer a database by recommending and implementing procedures including database tuning,
backup, query processing, query optimization and recovery.
6. To learn advanced querying with Decision support system and information retrieval.

**Course Outcome:**

At the end of successful completion of the course, students will be able to

1. Describe how database management systems function internally. Interpret and comparatively criticise database systems architectures.
2. Implement major components of a database management system and analyse their performance.
3. Analyse and compare the fundamental query evaluation and concurrency control algorithms. Identify strengths and weaknesses of query evaluation plans. Optimise query evaluation plans.
4. Identify trade-offs among database systems techniques and contrast distributed/parallel techniques for OLTP and OLAP workloads.

| **Module:1** | **8 Hours** |
|---|---|
| Formal review of relational database and FDs Implication, Closure, its correctness | |
| **Module:2** | **9 Hours** |
| 3NF and BCNF, Decomposition and synthesis approaches, Review of SQL99, Basics of query processing, external sorting, file scans | |
| **Module:3** | **10Hours** |
| Processing of joins, materialized vs. pipelined processing, query transformation rules, DB transactions, ACID properties, interleaved executions, schedules, serializability | |
| **Module:4** | **11 Hours** |
| Correctness of interleaved execution, Locking and management of locks, 2PL, deadlocks, multiple level granularity, CC on B+ trees, Optimistic CC | |
| **Module:5** | **8 Hours** |
| T/O based techniques, Multiversion approaches, Comparison of CC methods, dynamic databases, Failure classification, recovery algorithm, XML and relational databases | |
| **Total Lecture hours** | **46 hours** |

**Text Book**

1. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004

| | |
|---|---|
| 2. | A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008. |

**Reference Books**

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|---|---|
| 1. | K. V. Iyer, Lecture notes available as PDF file for classroom use. |

| DSCC | **Software Engineering** | **L** | **T** | **P** | **C** |
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| | | **3** | **0** | **0** | **3** |

**Prerequisite:** Basic programming skills and knowledge of database management system

**Course Objectives:**

Students will be able to–

1. To provide the idea of decomposing the given problem into Analysis, Designing, Implementation, Testing and Maintenance phases

2. To provide an idea of using various process models in the software industry according to given circumstances.

3. To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

**Course Outcome:**

At the end of successful completion of the course, students will be able to

1. Design and plan software solutions to real problems.
2. Identify a range of solutions and critically evaluate and justify proposed design solutions.
3. Test systems in terms of general quality attribute and possible trade-offs presented within the given problem.
4. Apply the knowledge, techniques, and skills in the development of a software product.

**Module: 1** — **10 hours**

**Introduction:** SE challenges – SE approach – Software process – Characteristics of SW process – SW development process model – S/W Engineering Paradigm – Software life cycle models .

**Module: 2** — **8 hours**

**Software Requirements** – Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modeling.

**Module: 3** — **10 hours**

**Software Project Management** - S/W cost estimation – Function point models – COCOMO model – Delphi method – S/W challenges – S/W maintenance.

**Module: 4** — **8 hours**

**Design Concepts and Principles** – Function-oriented software design – Object-oriented software design – Object modeling using UML – User interface design.

**Module: 5** — **10 hours**

**Software Testing and Quality Management** – Taxonomy of S/W testing – levels - black box testing – White box testing — regression testing– S/W testing strategies – unit testing – integration testing – validation testing – system testing and debugging, Quality concepts, quality assurance, software reviews, statistical quality assurance.

| | | |
|---|---|---|
| **Total Lecture hours** | | **46 hours** |
| **Text Book** | | |
| 1. | R. S. Pressman, Software Engineering - A practitioners approach, III Edition, McGraw Hill International editions, 1992 | |
| 2. | Ian Sommerville, Software Engineering, Pearson Education Asia, VI Edition, 2000 | |
| **Reference Books** | | |
| 1. | PankajJalote, An Integrated Approach to software Engineering, Springer Verlag, 1997 | |
| 2. | James F. Peters and WitoldPedryez, Software Engineering – An Engineering Approach, John Wiley and Sons, New Delhi | |

| OEC | **IMAGE PROCESSING** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **1** | **0** | **4** |

**Prerequisite:**Basic knowledge of Mathematics/ Statistics

**Course Objectives:**

Students will be able to–

1. To study the image fundamentals and mathematical transforms necessary for image processing.
2. To study the image enhancement techniques.
3. To study image restoration procedures.
4. To study the image compression procedures.

**Course Outcome:**

**Learning Outcomes** At the end of successful completion of the course, students will be able

CO1: Review the fundamental concepts of a digital image processing system.
CO2 : Analyze images in the frequency domain using various transforms.
CO3 : Evaluate the techniques for image enhancement and image restoration.
CO4 : Categorize various compression techniques.
CO5: Interpret image segmentation and representation techniques.

| **MODULE 1:Introduction** | **5Hours** |
|---|---|
| Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling andquantization | |
| **MODULE 2:Spatial Domain Filtering** | **6 Hours** |
| Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian | |
| **MODULE 3:Filtering in the Frequency Domain** | **6Hours** |
| Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering | |
| **MODULE 4: Image Segmentation** | 6 hours |
| Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's | |

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|---|
| method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation |
| **MODULE 5:Image Restoration** — **6 Hours** |
| Basic Framework, Interactive Restoration, Image deformation and geometric transformations, imagemorphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections |
| **MODULE 6**:**Image Compression** — 9 hours |
| Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an informationsource, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG,Lossless predictive coding, Lossy predictive coding, Motion Compensation |
| **MODULE6: Wavelet based Image Compression** — 6 hours |
| Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT),Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking |
| **MODULE7: Morphological Image Processing** — 6 hours |
| Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion |
| **MODULE8: Case Studies** — 10 |
| Different case studies on applications of Image Processing |
| **Total hours** — **60 hours** |
| **Text Book** |
| 1. Digital Image Processing by Rafael C Gonzalez &Richard E Woods, 3rd Edition |
| 2. Fundamentals of Digital Image Processing by Anil K Jain |
| **Reference Books** |
| 1. Digital Image Processing by William K Pratt |

| OEC | **Speech And Natural Language Processing** | **L** | **T** | **P** | **C** |
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| | | **3** | **1** | **0** | **4** |
| **Prerequisite:**Machine Learning | | | | | |
| **Course Objectives:** | | | | | |

Students will be able to–

1. Understand approaches to syntax and semantics in NLP.
2. Comprehend approaches to discourse, generation, dialogue and summarization within NLP.
3. Incorporate current methods for statistical approaches to machine translation.
4. Design machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods etc.

**Course Outcome:**

At the end of successful completion of the course, students will be able to :

1. Apply the principles and Process of Human Languages and identify semantics and pragmatics of thelanguages using computers.
2. Implement the current methods of statistical approaches to machine translation.
3. Perform POS tagging for a given natural language and Select a suitable language modelling technique based on the structure of the language.
4. Develop a Statistical Methods for Real World Applications and explore deep learning based NLP.

| **Module:1** | **5 Hours** |
|---|---|
| Human languages,models,ambiguity, processingparadigms; Phases innatural language processing,applications. Text representation in computers. | |

| **Module:2** | **6 Hours** |
|---|---|
| Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK. | |

| **Module:3** | **6 Hours** |
|---|---|
| Regular expressions, Finite State Automata, word recognition, lexicon.Morphology, acquisition models, Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF. | |

| **Module:4** | **6 Hours** |
|---|---|
| Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. | |

| **Module:5** | **8 Hours** |
|---|---|
| A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement,tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax. Parsing–Unification, probabilistic parsing, TreeBank | |

| **Module:6** | **7 Hours** |
|---|---|
| Meaningrepresentation,semanticanalysis, lexical semantics, WordNeZ. Word Sense Disambiguation–Selectional restriction, machine learning approaches, dictionary based approaches. | |

| **Module:7** | **6 Hours** |
|---|---|
| Reference resolution, constraints on co-reference, algorithm for pronounresolution, text coherence, discourse structure. | |

| **Module:8** | **6 Hours** |
|---|---|
| Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview. | |

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| **Module: 9** | | **10 Hours** |
| Different case studies on applications of Speech And Natural Language Processing | | |
| **Total Lecture hours** | | **60 hours** |
| **Text Book** | | |
| 1 | Daniel Jurafsky and James H. Martin. Speech and Language Processing, 2e, Pearson Education, 2009. | |
| 2 | Christopher D. Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing. MIT Press, 1999. | |
| **Reference Books** | | |
| 1 | James Allen, Natural language Understanding 2e, Pearson Education, 1994. | |
| 2 | Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit. | |
| 3 | Bharati A., Sangal R., ChaitanyaV., Natural language processing: a Paninian perspective, PHI, 2000. | |
| 4 | Siddiqui T., Tiwary U. S., Natural language processing and Information retrieval, OUP, 2008. | |
| 5 | Bing Liu. Sentiment Analysis and Opinion Mining, Morgan & Claypool Publishers | |
| 6 | Jacob Perkins, Python Text Processing with Nltk 2.0 Cookbook | |

| DSCC | **Machine Learning** | **L** | **T** | **P** | **C** |
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| | | **3** | **0** | **0** | **3** |

**Prerequisite:**

**Course Objectives:**

Students will be able to–

1. Understand the basic theory underlying machine learning.
2. Formulate machine learning problems corresponding to different applications.
3. Understand a range of machine learning algorithms along with their strengths and weaknesses.
4. Apply machine learning algorithms to solve problems of moderate complexity.
5. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

**Course Outcome:**

At the end of successful completion of the course, students will be able to

1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Understand the strengths and weaknesses of many popular machine learning approaches.
3. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
4. Design and implement various machine learning algorithms in a range of real-world applications.

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|---|---|
| **Module:1 (Introduction)** | **8 Hours** |
| Definition of Learning systems; Goals and applications of Machine learning, Aspects of developing a learning system, training data, Problems, data and tools, supervised vs. unsupervised learning. | |
| **Module:2 (Data preprocessing and visualization)** | **8 Hours** |
| Data cleaning and preprocessing, Feature engineering, Handling Outliers, Data visualization | |
| **Module:3 (Model evaluation and selection)** | **6 Hours** |
| Model performance metrics, Bias-variance tradeoff, Cross-validation, Grid search | |
| **Module:4 (Supervised learning)** | **10 Hours** |
| Linear regression, Logistic regression, Decision trees, Random forests, Support vector machines, Naive Bayes, K-nearest neighbors, Neural networks | |
| **Module:5(Unsupervised learning)** | **7 Hours** |
| K-means clustering, Hierarchical clustering, DBSCAN clustering, Principal component analysis, | |
| **Module :6 (Applications of machine learning)** | **6 Hours** |
| Natural language processing, Image recognition, Recommender systems, Fraud detection | |
| **Total Lecture hours** | **46 hours** |

**Text Book**

| | |
|---|---|
| 1. | Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 1st ed. 2006 |
| 2. | Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Shroff/O'Reilly; Third edition (2022) |
| 3 | Tom Mitchell, Machine Learning, First Edition, McGraw- Hill (1997) |

**Reference Books**

| | |
|---|---|
| 1. | Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd., Third edition (2015) |
| 2 | Kevin Patrick Murphy, Machine Learning: a Probabilistic Perspective, MIT Press, 2012. |

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|---|---|
| 3 | Sebastian Raschka, Machine Learning Q and AI. |
| 4 | David Barber, Bayesian Reasoning and Machine Learning, Cambridge University Press |
| 5 | Richard S. Sutton, Andrew G. Barto, Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning) MIT Press; second edition (2018). |
| 6 | A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, Published by Cambridge University Press, 2020. |
| 7 | Yudi Pawitan, In All Likelihood: Statistical Modelling And Inference Using Likelihood, Oxford University Press, 1st edition (2013) |


| ESC | **MACHINE LEARNING LAB** | **L** | **T** | **P** | **C** |
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| | | **0** | **0** | **4** | **2** |

**Prerequisite:**Basic knowledge of Python/Java,C-C++

**Course Objectives:**

Students will be able to–

1. Understand the mathematical and statistical prospective of machine learning algorithms through python programming.
2. Formulate machine learning problems corresponding to different applications.
3. Apply a range of machine learning algorithms along with their strengths and weaknesses.

**Course Outcome:**

At the end of successful completion of the course, students will be able to

4. Design and evaluate the unsupervised models through python in built functions.
5. Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming.
6. Design and apply various reinforcement algorithms to solve real time complex problems.
7. Design application using machine learning techniques

| **Practical experiments:** | **24 Hours** |
|---|---|

1. Write a programme using Python to implement the Naive Bayes Classifier.
2. Write a programme using Python to implement the Decision Trees.
3. Write a programme using Python to implement the Linear Regression with one variable.
4. Write a programme using Python to implement the Linear Regression with multiple variable.
5. Write a programme using Python to implement the Logistic Regression with multiple variables .
6. Write a programme using Python to implement theBack-propagation Algorithm.

7. Write a programme using Python to implement the Artificial Neural Network.
8. Write a programme using Python to implement the SVM.
9. Write a programme using Python to implement the K-means clustering algorithm.
10. Write a programme using Python to implement the PCA.

**Text Book**

1. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, The MIT Press.
2. Simon O. Haykin, "Neural Networks and Learning Machines", Pearson Education, 2016.

**Reference Books**

1. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2010.
2.. Andrew NG, "Machine Learning Yearning", Amazon.com Services LLC, Kindle Edition, 2019.

| DSCC | **Advanced DBMS Lab** | **L** | **T** | **P** | **C** |
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| | | **0** | **0** | **4** | **2** |

**Prerequisite:** Basic programming skills

**Course Objectives:**

Students will be able–
1. To explore the features of a Database Management Systems
2. To interface a database with front end tools
3. To understand the internals of a database system

**Course Outcome:**

At the end of successful completion of the course, students will be able to

5. Apply various advanced queries such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL
6. Create relational Database system.
7. Analyze the internals of a database system.

**Experiments**

Students will perform experiments on the following topics:

1. Data Definition Language Commands
2. Data Manipulation Language Commands
3. Data Control Language, Transfer control Language Commands
4. In Built Functions
5. Nested Queries and Join Queries

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|---|
| 6. Set Operations<br>7. Views<br>8. Control Structure<br>9. Procedure and Function<br>10. 10. Trigger |
| **Total Lab hours** — **30 hours** |
| **Reference Books** |
| 1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 6th edition, Tata McGraw Hill, 2011 |
| 2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 4th Edition, Pearson/Addision wesley, 2007 |

## School of Engineering & Technology
## Department of Computer Science and Engineering
### M.Sc. – Computer Science (With Specialisation in Artificial Intelligence)
### SEMESTER - III

| DSCC | DEEP LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Prerequisite:** Basic knowledge of Statistics

**Course Objectives:**

Students will be able to–

1. Understand the mathematical and statistical prospective of deep learning algorithms through python programming.
2. Formulate deep learning problems corresponding to different applications.
3. Apply a range of deep algorithms along with their strengths and weaknesses.

**Course Outcome:**

**Learning Outcomes** At the end of successful completion of the course, students will be able

1. To understand the role of deep neural networks in engineering, artificial intelligence, and cognitive modelling through the study of the most important deep neural network models.

2. To solve the problems using various deep learning techniques.

3. To design application using deep learning techniques.

| **Module 1: Basics of Deep Learning** | **11 Hours** |
|---|---|

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic,

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|---|
| Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent: Momentum, Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Feed forward Neural Networks, Representation Power of Feed forward Neural Networks, Feed forward Neural Networks and Back propagation |
| **Module 2: Deep Feed Forward Neural Networks:** **12 Hours** |
| Gradient based learning; hidden units; architecture design; back-propagation; hyperparameters.Regularization and Practical Aspects of Deep Learning: Regularization and under-constrained problems, dataset augmentation, noise robustness, early stopping, bagging, dropout, normalizing inputs; vanishing/exploding gradients, weight initialization for deep networks; hyperparameter tuning; batch normalization. |
| **Module 3:Convolution Neural Networks and Recurrent Neural Networks** **12 Hours** |
| Convolutional Neural Networks, CNN architectures: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs, Encoder Decoder Models, Attention Mechanism, Attention over images |
| **Module:4 Case studies** **10 Hours** |
| Image Classification/ Text Classification |
| **Total hours** **45 hours** |

**Text Book**

| | |
|---|---|
| 1. | Simon O. Haykin, "Neural Networks and Learning Machines", Pearson Education, 2016. |
| 2. | Nielsen, Michael A., Neural Networks and Deep Learning, 2015. |

**Reference Books**

| | |
|---|---|
| 1. | Chollet, Franois. Deep Learning with Python, 2017. |
| 2.. | Buduma, Nikhil, and Nicholas Locascio, Fundamentals of Deep Learning: Designing Next-generation Machine Intelligence Algorithms, O'Reilly Media, Inc., 2017. |

| DSCC | **Operating System** | **L** | **T** | **P** | **C** |
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| | | **3** | **0** | **0** | **3** |

**Prerequisite:**Programming skills (Knowledge of C), elementary data structures and algorithms, computer architecture.

**Course Objectives:**

1. To learn and understand the Concepts of operating system
2. The core structure, functions and design principles of operating system
3. To Learn and understand operating system services
4. Interposes communications and basic concepts of virtualization

**Course Outcome:**

On successful completion of the course,

1. Explain fundamental of operating system and Compare Various Algorithm used for CPU Schedul Synchronization and Disk Scheduling Algorithm.
2. Apply various concepts related with Deadlock and Memory management to solve Problems.
3. Analyse File Systems Management, I/O Management, Protection and Security Mechanism in Op System.
4. Develop practical knowledge on shell Programming, thread, process, scheduling algorithms on di environment of Operating System.

| **Module: 1** | **7 hours** |
|---|---|

Architecture, Goals & Structures of O.S, Basic functions, Interaction of O. S. & hardware architecture, System calls, Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S.

| **Module:2** | **8 hours** |
|---|---|

Process Concept, Process states, Process control, Threads, Uni-processor Scheduling: Types of scheduling: Preemptive, Non preemptive, Scheduling algorithms: FCFS, SJF, RR, Priority, Thread Scheduling, Real Time Scheduling. System calls like ps, fork, join, exec family, wait.

| **Module:3** | **8 hours** |
|---|---|

Basic Concepts of Concurrency, Cooperating process, Advantage of Cooperating process, Bounded-Buffer - Shared-Memory Solution, Inter-process Communication (IPC), Basic Concepts of Inter-process Communication and Synchronization

| **Module: 4** | **7 hours** |
|---|---|

Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, System calls like signal, kill.

| **Module: 5** | **8 hours** |
|---|---|

Memory Management requirements, Memory partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit, and Worst Fit), Fragmentation, Swapping, and Paging. Segmentation, Demand paging Virtual Memory: Concepts, management of VM, Page Replacement Policies (FIFO, LRU, Optimal, Other Strategies), Thrashing.

| **Module: 6** | **8 hours** |
|---|---|
| I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting. | |
| **Total Lecture hours** | **46hours** |

**Text Books**

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

**Reference Book**

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the UNIX Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India

| ESC | **Big Data Analytics** | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Prerequisite:** Basic knowledge of Mathematics/ Statistics/Programming

**Course Objectives:**

This course gives an overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.

**Course Outcome:**

**Learning Outcomes** At the end of successful completion of the course, students will be able to

CO1: Understand Big Data and its analytics in the real world
CO2 : Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics
CO3 : Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm
CO4 :Design and Implementation of Big Data Analytics using Spark to solve data

| | |
|---|---|
| intensive problems and to generate analytic | |
| **MODULE 1:Introduction** | **10 Hours** |
| Introduction to Big Data, introduction to Enabling Technologies for Big Data, introduction to Big Data Platforms, introduction to Big Data Storage Platforms for Large Scale Data Storage, introduction to Big Data Streaming Platforms for Fast Data, Relationships and Representations, Graph Databases. | |
| **MODULE 2: Mapreduce Programming** | **12 Hours** |
| Introduction , Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression, Real time applications using MapReduce, Data serialization and Working with common serialization formats, Big data serialization formats. | |
| **MODULE 3:Big Data Applications** | **12 Hours** |
| Introduction to Big Data Applications using machine learning | |
| **MODULE 4:Introduction to Spark** | **12 Hours** |
| Introduction to Spark, introduction of big data Machine learning with Spark, Language processing with Spark, Analysis of Streaming Data with Spark, Applications of Spark ML Library, Basic Neural Network and Tensor Flow | |
| **Total hours** | **46 hours** |

**Text Books**

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1. Seema Acharya, Subhashini Chellappan, “Big Data Analytics”, 1st Edition, Wiley, 2015

**Reference Books**

1. Dirk Deroos et al., Hadoop for Dummies, Dreamtech Press, 2014.

2. Chuck Lam, Hadoop in Action, December, 2010.

3. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, Cambridge University Press.

4. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques.

5. Erik Brynjolfsson et al., The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies, W. W. Norton & Company, 2014

6. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, 1 st

Edition, Wrox, 2013.

7. Chris Eaton, Dirk Deroos et. al., "Understanding Big data", Indian Edition, McGraw Hill, 2015.

8. Tom White, "HADOOP: The definitive Guide", 3 rd Edition, O Reilly, 2012.

0. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", 1 st Edition, Packet Publishing Limited, 2013

| DSC C | **Data Science** | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**Course Objective:**
Data Science is a fast-growing interdisciplinary field, focusing on the analysis of data to extract knowledge and insight. This course will introduce students to the collection. Preparation, analysis, modelling, and visualization of data, covering both conceptual and practical issues. Examples and case studies from diverse fields will be presented, and hands-on use of statistical and data manipulation software will be included.

**Course Outcomes**
CO 1: Understand the processes of data science - identifying the problem to be solved, data collection, preparation, modelling, evaluation, and visualization.
CO 2: Able to develop and appreciate various techniques for data modelling and mining.
CO 3: Be cognizant of ethical issues in many data science tasks.
CO 4: Learn skills to analyse real time problems using Python/R
CO 5: Able to do the exploratory data analysis on real time datasets using Python/R

| Module | Topic | Course Content | Hours |
|---|---|---|---|
| I | Introduction | Introduction, Toolboxes: Python, fundamental libraries for data Scientists. Integrated development environment (IDE). Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting. | 9 |
| II | Descriptive Staistics | Descriptive statistics, data preparation. Exploratory Data Analysis data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score. Statistical Inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using p-values | 11 |
| III | Supervised | Supervised Learning: First step, learning curves, | 9 |

| | | | |
|---|---|---|---|
| | Learning | training-validation and test. Learning models generalities, support vector machines, random forest. Examples | |
| IV | Regression Analysis | Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Sparse model. Unsupervised learning, clustering, similarity and distances, quality measures of clustering, case study. | 11 |
| V | Network Analysis | Network Analysis, Graphs, Social Networks, centrality, drawing centrality of Graphs, PageRank, Ego-Networks, community Detection | 10 |
| VI | Case Studies | Perform case studies and experiments on different examples and applications of Data Science | 10 |
| | | Total | 60 |

**TEXT/REFERENCES BOOK**

1. Introduction to Data Science a Python approach to concepts, Techniques and Applications, Igual, L;Seghi', S. Springer, ISBN:978-3-319-50016-4
2. Data Analysis with Python A Modern Approach, David Taieb, Packt Publishing, ISBN-9781789950069
3. Python Data Analysis, Second Ed., Armando Fandango, Packt Publishing, ISBN: 9781787127487

| | | L | T | P | C |
|---|---|---|---|---|---|
| DSCC | **Advanced Web Technology** | **3** | **0** | **0** | **3** |

**Prerequisite:**

**Course Objectives:**

Students will be able to–

4. Understand the mathematical and statistical prospective of machine learning algorithms through python programming.
5. Formulate machine learning problems corresponding to different applications.
6. Apply a range of machine learning algorithms along with their strengths and weaknesses.

**Course Outcome:**

At the end of successful completion of the course, students will be able to

8. Design and evaluate the unsupervised models through python in built functions.
9. Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming.
10. Design and apply various reinforcement algorithms to solve real time complex problems.
11. Design application using machine learning techniques

**Module:1 AN INTRODUCTION TO WEB TECHNOLOGY** **6 Hours**

History of web Development, Time line, Motivation, Categories of Web Applications, Characteristics of

Web Applications. Evolution and Need for Web Engineering, Web Engineering Models, Software Engineering v/s Web Engineering World Wide Web: Introduction to TCP/IP and WAP, DNS, Email, TelNet, HTTP and FTP. Introduction to Browser and search engines, Search fundamentals, Search strategies, Directories search engines and Meta search engines, Working of the search engines, Miscellaneous Web Browser details, Introduction to Web Servers: Features of web servers, caching, case study-IIS, Apache, Configuring web servers.

| **Module:2 INFORMATION ARCHITECTURE** | **9 Hours** |
|---|---|

The role of the Information Architect, Collaboration and Communication, Organizing Information, Organizational Challenges, Organizing Web sites parameters and Intranets Creating Cohesive Websites: Conceptual Overview Website Development, Website Design issues, Conceptual Design, High-Level Design, Indexing the Right Stuff, Grouping Content. Architectural Page Mockups, Design Sketches, Navigation Systems. Searching Systems Good & bad web design, Process of Web Publishing. Phases of Web Site development, enhancing your web-site, submission of website to search engines Web security issues, security audit of websites, Web effort estimation, Productivity, Measurement, Quality usability and reliability. Requirements Engineering for Web Applications: Introduction, Fundamentals, Requirement Source, Type, Notations Tools. Principles Requirements Engineering Activities, Adapting RE Methods to Web Application.

| **Module:3 TECHNOLOGIES FOR WEB APPLICATIONS** | **11Hours** |
|---|---|

HTML and DHTML, HTML Basic Concepts, Static and dynamic HTML, 8 Class Hours/week 4 Expected weeks 12 Total hrs. of classes 36+12 = 48 ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY Page 6 Structure of HTML documents, HTML Elements, Linking in HTML, Anchor Attributes, Image Maps, Meta Information, Image Preliminaries, Layouts, Backgrounds, Colors and Text, Fonts, Tables, Frames and layers, Audio and Video Support with HTML Database integration, CSS, Positioning with Style sheets, Forms Control, Form. Elements. Introduction to CGI PERL, JAVA SCRIPT, PHP, ASP, Cookies Creating and Reading Cookies.Error Analysis : Utility of error analysis, Precision/Recall, Error Metrics for Skewed Classes

| **Module:4 TECHNOLOGIES FOR WEB APPLICATIONS** | **10 Hours** |
|---|---|

Introduction of XML, Validation of XML documents, DTD, Ways to use XML, XML for data files, HTML Vs XML, Embedding XML into HTML documents, Converting XML to HTML for Display, Displaying XML using CSS and XSL, Rewriting HTML as XML, Relationship between HTML, SGML and XML, web personalization, Semantic web, Semantic Web Services, Ontology.

| **Module:5 E- COMMERCE** | **9 Hours** |
|---|---|

E-commerce Business Models, The Internet and World Wide Web: E-commerce Infrastructure, Building an E-commerce Web Site, Electronic Commerce environment and opportunities. Modes of Electronic Commerce, Approaches to safe Electronic Commerce, Electronic Cash and Electronic Payment Schemes ,Online Security and Payment Systems, Ecommerce Marketing Concepts, Advertising on the Internet: issues an Technologies, Ecommerce Marketing Concepts Electronic Publishing issues, approaches, legalities and technologies, Privacy and Security Topics: Introduction, Web Security , Encryption schemes, Secure Web document, Digital Signatures and Firewalls, Cyber crime and laws, IT Act.

| **Total hours** | **45 hours** |
|---|---|

**Text Book**

| | |
|---|---|
| 1. | Roger S.Pressman, David Lowe, “Web Engineering”, Tata Mcgraw Hill Publication, 2007 |
| 2. | Achyut S Godbole and AtulKahate, “Web Technologies”, Tata McGraw Hill |
| 3. | Gopalan N P, Akilandeswari “Web Technology: A Developer s Perspective”, PHI |

**Reference Books**

| | |
|---|---|
| 1. | CHRIS BATES Web Programming: Building Internet applications Wiley |
| 2. | Beginning XML 4th Edition Hnter, Refter, Fawset Wiley India . |
| 3. | Internet & World Wide Web How to Program, Pearson education, 3rd edition, by: H.M. Deitel, P.J. Deitel, A.B. Goldberg |

| ESC | **DEEP LEARNING LAB** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **4** | **2** |

**Prerequisite:** Basic knowledge of Python

**Course Objectives:**

Students will be able to–

1. Understand the mathematical and statistical prospective of deep learning algorithms through python programming.
2. Formulate deep learning problems corresponding to different applications.
3. Apply a range of deep algorithms along with their strengths and weaknesses.

**Course Outcome:**

At the end of successful completion of the course, students will be able

1. To understand the role of deep neural networks in engineering, artificial intelligence, and cognitive modelling through the study of the most important deep neural network models.
2. To solve the problems using various deep learning techniques.
3. To design application using deep learning techniques.

| **Practical experiments:** | **24 Hours** |
|---|---|

11. Write a program using Python to implement Self Organizing Maps (SOMs).
12. Write a program using Python to implement the Multilayer Perceptrons (MLPs)
13. Write a program using Python to implement the Radial Basis Function Networks.
14. Write a program to implement Autoencoder.
15. Write a program using Python to implement Convolutional Neural Networks (CNNs).
16. Write a program using Python to implement the Recurrent Neural Networks (RNNs).
17. Write a program using Python to implement the Long Short Term Memory Networks (LSTMs)
18. Write a program to implement encoder-decoder architecture with Attention Mechanism
19. Write a program using Python to implement the Generative Adversarial Networks (GANs).

**Text Book**

1. Simon O. Haykin, "Neural Networks and Learning Machines", Pearson Education,

| | |
|---|---|
| | 2016. |
| 2. | Nielsen, Michael A., Neural Networks and Deep Learning, 2015. |
| **Reference Books** | |
| 1.<br>2.. | Chollet, Franois. Deep Learning with Python, 2017.<br><br>Buduma, Nikhil, and Nicholas Locascio, Fundamentals of Deep Learning: Designing Next-generation Machine Intelligence Algorithms, O'Reilly Media, Inc., 2017. |

| AEC | **MINOR PROJECT** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **8** | **4** |
| Guidelines will providedby the Universityfrom time to time | | | | | |

| SEC | **SEMINAR PAPER** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **2** | **1** |
| Guidelines will providedby the Universityfrom time to time | | | | | |

## School of Engineering & Technology
## Department of Computer Science and Engineering
### M.Sc. – Computer Science (With Specialisation in Artificial Intelligence)
### SEMESTER –IV

| VAC | **Universal Human Values** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **2** | **1** | **0** | **3** |

| Guidelines will providedby the Universityfrom time to time |
|---|

| IC | **Elective-IV ( As per Table)(As per SWAYAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |
| Guidelines will providedby the Universityfrom time to time | | | | | |
| 1. Quantum Computing<br>2. Molecular Computing<br>3. Nano Technology<br>4. Robotics<br>5. Remote Sensing & GIS | | | | | |

| DSCC | **Elective-V ( As per Table)(As per SWAYAM)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |
| Guidelines will providedby the Universityfrom time to time | | | | | |
| 1. Internet of Things<br>2. Computer network and Internet security<br>3. Wireless Networks<br>4. Android Mobile Application Dev<br>5. Database and content organization | | | | | |

| AEC / SEC | **System Development Project** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **22** | **11** |
| Guidelines will providedby the Universityfrom time to time | | | | | |