Paper Code(s): ES-201	**L**	**P**	**C**
Paper: Computational Methods	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand numerical methods to find roots of functions and first order unconstrained minimization of functions.
2.	To introduce concept of interpolation methods and numerical integration.
3.	To understand numerical methods to solve systems of algebraic equations and curve fitting by splines.
4.	To understand numerical methods for the solution of Ordinary and partial differential equations.

Course Outcomes (CO)

CO 1	Ability to develop mathematical models of low level engineering problems
CO 2	Ability to apply interpolation methods and numerical integration.
CO 3	Ability to solve simultaneous linear equations and curve fitting by splines
CO 4	Ability to numerically solve ordinary differential equations that are initial value or boundary value problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	2	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	3	3	2	-	-	-	2	2	2	3
CO 4	3	3	3	3	2	-	-	-	2	2	2	3

UNIT-I

Review of Taylor Series, Rolle 's Theorem and Mean Value Theorem, Approximations and Errors in numerical computations, Data representation and computer arithmetic, Loss of significance in computation
Location of roots of equation: Bisection method (convergence analysis and implementation), Newton Method (convergence analysis and implementation), Secant Method (convergence analysis and implementation). Unconstrained one variable function minimization by Fibonacci search, Golden Section Search and Newton's method. Multivariate function minimization by the method of steepest descent, Nelder- Mead Algorithm.

UNIT-II

Interpolation: Assumptions for interpolation, errors in polynomial interpolation, Finite differences, Gregory-Newton's Forward Interpolation, Gregory-Newton's backward Interpolation, Lagrange's Interpolation, Newton's divided difference interpolation
Numerical Integration: Definite Integral, Newton-Cote's Quadrature formula, Trapezoidal Rule, Simpson's one-third rule, simpson's three-eight rule, Errors in quadrature formulae, Romberg's Algorithm, Gaussian Quadrature formula.

UNIT-III

System of Linear Algebraic Equations: Existence of solution, Gauss elimination method and its computational effort, concept of Pivoting, Gauss Jordan method and its computational effort, Triangular Matrix factorization methods: Dolittle algorithm, Crout's Algorithm, Cholesky method, Eigen value problem: Power method Approximation by Spline Function: First-Degree and second degree Splines, Natural Cubic Splines, B Splines, Interpolation and Approximation

UNIT - IV

Numerical solution of ordinary Differential Equations: Picard's method, Taylor series method, Euler's and Runge-Kutta's methods, Predictor-corrector methods: Euler's method, Adams-Bashforth method, Milne's method.
Numerical Solution of Partial Differential equations: Parabolic, Hyperbolic, and elliptic equations
Implementation to be done in C/C++

Textbook(s):
1. E. Ward Cheney & David R. Kincaid , "Numerical Mathematics and Computing" Cengage; 7th ed (2013).

References:
1. R. L. Burden and J. D. Faires, "Numerical Analysis", CENGAGE Learning Custom Publishing; 10th Edition (2015).
2. S. D. Conte and C. de Boor, "Elementary Numerical Analysis: An Algorithmic Approach", McGraw Hill, 3rd ed. (2005).
3. H. M. Antia, "Numerical Methods for Scientists & Engineers", Hindustan Book Agency, (2002).
4. E Balagurusamy "Numerical Methods" McGraw Hill Education (2017).

Paper Code(s): HS-203	**L**	**P**	**C**
Paper: Indian Knowledge System	**2**	**-**	**2**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the Indian knowledge System.
2.	To understand the foundational concepts for science and technology.
3.	To understand the ancient Indian mathematics and astronomy.
4.	To understand the ancient Indian engineering and technology.

Course Outcomes (CO)

CO 1	Ability to understand the Indian knowledge System.
CO 2	Ability to understand and apply foundational concepts for science and technology.
CO 3	Ability to understand and apply ancient Indian mathematics and astronomy
CO 4	Ability to understand ancient Indian engineering and technology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	-	-	-	-	2
CO 2	-	-	-	-	-	3	-	-	-	2	-	2
CO 3	3	3	-	-	-	-	-	-	-	-	-	2
CO 4	3	3	-	-	-	-	-	-	-	-	-	2

UNIT-I

Indian Knowledge System (IKS) - An Introduction:
Overview of IKS - Importance of Ancient Knowledge; Defining IKS; The IKS Corpus – A Classification Framework; Chaturdaśa-Vidyāsthāna; History of IKS, Some unique aspects of IKS;
The Vedic Corpus – Introduction to Vedas; The Four Vedas and their divisions; Vedāngas; Vedic Life;
Philosophical Systems – Indian Philosophical Systems; Vedic Schools of Philosophy; Non-Vedic Philosophical Systems; Wisdom through the Ages – Purānas, Itihāsa as source of wisdom, Rāmāyana, Mahābhārata, Niti-śāstras, Subhāssitas.

UNIT-II

Foundational Concepts for Science and Technology:
Linguistics - Components of Language; Pānini's work on Sanskrit Grammar; Phonetics in Sanskrit; Patterns in Sanskrit Vocabulary; Computational Concepts in Astādhyāyi, Logic for Sentence Construction; Importance of Verbs; Role of Sanskrit in Natural Language Processing

Number System and Units of Measurement – Number System in India; Salient Features of the Indian Numeral System; Unique approaches to represent numbers; Measurements for Time, Distance and Weight; Pingala and the Binary System
Knowledge: Framework and Classification – The Knowledge Triangle; Prameya; Pramāna; Samśaya; Framework for establishing Valid Knowledge

UNIT-III

Mathematic and Astronomy in IKS:
Mathematics – Unique aspects of Indian Mathematics; Great Mathematicians and their Contributions; Arithmetic; Geometry; Trigonometry; Algebra; Binary Mathematics and Combinatorial Problems in Chandah-śāstra of Pingala, Magic Squares in India
Astronomy - Unique aspects of Indian Astronomy; Historical Development of Astronomy in India; The Celestial Coordinate System; Elements of the Indian Calendar; Āryabhatiya and the Siddhāntic Tradition; Pancānga; Astronomical Instruments; Jantar Mantar of Rājā Jai Singh Sawai

UNIT - IV

Engineering and Technology in IKS:
Engineering and Technology: Metals and Metalworking – The Indian S & T Heritage; Mining and Ore Extraction; Metals and Metalworking Technology; Iron and Steel in India; Lost wax casting of Idols and Artefacts; Apparatuses used for Extraction of Metallic Components
Engineering and Technology: Other Applications – Literary sources for Science and Technology; Physical Structures in India; Irrigation and Water Management; Dyes and Painting Technology; Surgical Techniques; Shipbuilding; Sixty-four Art Forums; Status of Indigenous S & T

Textbook(s):
1. B. Mahadevan, Vinayaka Rajat Bhat & Nagendra Pavana R.N., "Introduction to Knowledge System: Concepts and Applications" PHI (2022).

References:
1. C.M Neelakandhan & K.A. Ravindran, "Vedic Texts and The Knowledge Systems of India", Sri Sankaracharya University of Sanskrit, Kalady (2010).
2. P.P. Divakaran, "The Mathematics of India: Concepts, Methods, Connections", Springer (2018)
3. C.A. Sharma, "Critical Survey of Indian Philosophy", Motilal Banarasidass Publication (1964)
4. G. Huet, A. Kulkarni & P. Scharf, "Sanskrit Computational Linguistics", Springer (2009).
5. A.K. Bag, "History of Technology in India", Indian National Science Academy, Vol 1, (1997)

Paper Code(s): CIC-205	**L**	**P**	**C**
Paper: Discrete Mathematics	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the concept of Mathematical Logic, concepts of sets, relation and functions
2.	To introduce the concept of Algorithm and number theory
3.	To understand Group theory and related examples
4.	To use Graph theory for solving problems

Course Outcomes (CO)

CO1:	Ability for constructing mathematical logic to solve problems
CO2:	Ability to Analyze/ quantify the efficiency of a developed solution (algorithm) of a computational problem
CO3:	Ability to Understand mathematical preliminaries to be used in the subsequent courses of the curriculum. This includes Boolean algebra, number theory, group theory, and combinatorics.
CO4:	Ability to Understand diverse relevant topics in discrete mathematics and computation theory with an emphasis on their applicability as mathematical tools in computer science.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	2	2	-	-	-	2	2	3	3
CO 2	3	3	3	2	2	-	-	-	2	2	3	3
CO 3	3	3	3	3	2	-	-	-	2	2	3	3
CO 4	3	3	3	3	2	-	-	-	2	2	3	3

UNIT – I

Sets, Logic, and Relation: Sets, Subsets, powerset, operations on sets, Propositional Logic, Rules of inferences in propositional logic, Quantifiers, Predicates and validity, Predicate Logic, normal forms. Proof Techniques- Direct Proof, Proof by Contraposition, and proof by contradiction. Principle of inclusion and exclusion, pigeonhole principle, permutation and combination. Principle of Well Ordering, principle of mathematical induction, principle of complete induction. Relation, properties of binary relation, equivalence relation and class, closures (symmetric, reflexive, and transitive).

UNIT – II

Functions, Order relations and Boolean Algebra: Functions, Growth of functions, Permutation functions, Partially ordered sets, lattices, Boolean algebra, Minimization of Boolean Expressions. GCD, LCM, prime numbers.

Recurrence relations, solution methods for linear, first-order recurrence relations with constant coefficients, generating functions, Analysis of Algorithms involving recurrence relations, solution method for a divide-and-conquer recurrence relation. Masters theorem (with proof).

UNIT – III

Group theory: Semi-group, Monoid, Groups, Group identity and uniqueness, inverse and its uniqueness, isomorphism and homomorphism, subgroups, Cosets and Lagrange's theorem, Permutation group and Cayley's theorem (without proof), Normal subgroup and quotient groups. Groups and Coding.

UNIT – IV

Graph theory: Graph Terminology, Planar graphs, Euler's formula (proof), Euler and Hamiltonian path/circuit. Chromatic number of a graph, five color theorem (proof), Shortest path and minimal spanning trees and algorithms, Depth-first and breadth first search, trees associated with DFS & BFS, Connected components. Complexity Analysis of the graph MST.

Textbook(s):

1. B. Kolman, R. C. Busby & S.C. Ross "Discrete Mathematical Structures", 6th edition, PHI/Pearson, 2009.
2. R. L. Graham, D. E. Knuth & O. Patashnik, "Concrete Mathematics", Pearson Education, 2000.

References:

1. Neal Koblitz, "A course in number theory and cryptography", Springer – Verlag, 1994.
2. J.P. Tremblay & R. Manohar, "Discrete Mathematical Structure with Application to Computer Science," TMH, New Delhi (2000).
3. Norman L. Biggs, "Discrete Mathematics", Second edition, Oxford University Press, New Delhi (2002).
4. T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd edition, PHI/Pearson.
5. Anne Benoit, Yves Robert, Frédéric Vivien "A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis", CRC Press, 2013.

Paper Code(s): ECC-207	**L**	**P**	**C**
Paper: Digital Logic and Computer Design	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basic concepts of Boolean Algebra and Combinational Logic
2.	To introduce various sequential circuits, designing with examples
3.	To relate combination circuit design and sequential circuit design with respect to the design of a computer system
4.	To introduce machine learning, computer arithmetic, modes of data transfer with respect to I/O and Memory organization of a computer

Course Outcomes (CO) :

CO 1	Ability to understand Boolean Algebra and Design Combinational Circuits .
CO 2	Ability to understand and Design Sequential Circuits.
CO 3	Ability to understand Design of a basic computer.
CO 4	Ability to understand Input-Output and Memory Organization of a Computer.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	2	2	-	-	-	3	2	2	3
CO 2	3	2	3	2	2	-	-	-	3	2	2	3
CO 3	3	2	3	3	2	-	-	-	3	2	2	3
CO 4	3	3	3	3	3	-	-	-	3	2	2	3

UNIT – I

Boolean Algebra and Combinational Logic: Review of number systems , signed, unsigned, fixed point, floating point numbers, Binary Codes, Boolean algebra – basic postulates, theorems , Simplification of Boolean function using Karnaugh map and Quine-McCluskey method – Implementations of combinational logic functions using gates, Adders, Subtractors, Magnitude comparator, encoder and decoders, multiplexers, code converters , parity generator/checker, implementation of combinational circuits using multiplexers.

UNIT – II

Sequential Circuits: General model of sequential circuits, Flip-flops, latches , level triggering, edge triggering, master slave configuration , concept of state diagram , state table, state reduction procedures , Design of synchronous sequential circuits , up/down and modulus counters , shift registers, Ring counter , Johnson counter , timing diagram , serial adder , sequence detector, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Memory Unit, Random Access Memory

UNIT – III

Basic Computer organization: Stored Program, Organization, Computer registers, bus system, instruction set completeness, instruction cycle, Register Transfer Language, Arithmetic, Logic and Shift Micro-operations, Instruction Codes, Design of a simple computer, Design of Arithmetic Logic unit, shifter, Design of a simple hardwired control unit, Programming the basic computer, Machine language instructions, assembly language, Microprogrammed control, Horizontal and Vertical Microprogramming, Central Processing Unit, instruction sets and formats, addressing modes, data paths, RISC and CISC characteristics.

UNIT – IV

Computer Arithmetic, addition, subtraction, multiplication and division algorithms, Input-Output Organization, Modes of data transfer, Interrupt cycle, direct memory access, Input-Output processor, Memory Organization, Memory Hierarchy, Associative Memory, Cache Memory, Internal and external Memory, Virtual Memory.

Text Book(s)

1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016
2. M. Morris Mano, Rajib Mall "Computer System Architecture", 3rd Edition Pearson Education, 2017

References:

1. Leach, D. P., Albert P. Malvino, "Digital Principles and Applications", McGraw Hill Education, 8th Edition , 2014
2. Jain, R.P. ,"Modern Digital Electronics", McGraw Hill Education, 4th Edition , 2010
3. Floyd, Thomas L. , "Digital Fundamentals" Pearson Education, 11th Edition, 2017
4. M. Rafiquzzaman, "Fundamentals of Digital Logic and Microcomputer Design", Wiley, 5th Ed., 2005.

Paper Code(s): CIC-209	**L**	**P**	**C**
Paper: Data Structures	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basics of Data structures (Arrays, strings, linked list etc.)
2.	To understand the concepts of Stacks, Queues and Trees, related operations and their implementation
3.	To understand sets, heaps and graphs
4.	To introduce various Sorting and searching Algorithms

Course Outcomes (CO)

CO 1	To be able to understand difference between structured data and data structure
CO 2	To be able to create common basic data structures and trees
CO 3	To have a knowledge of sets, heaps and graphs
CO 4	To have basic knowledge of sorting and searching algorithms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	2	2	3
CO 2	3	2	2	2	3	-	-	-	2	2	2	3
CO 3	3	2	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	2	2	3	-	-	-	2	2	2	3

UNIT – I

Overview of data structure, Basics of Algorithm Analysis including Running Time Calculations, Abstract Data Types, Arrays, Arrays and Pointers, Multidimensional Array, String processing, General Lists and List ADT, List manipulations, Single, double and circular lists. Stacks and Stack ADT, Stack Manipulation, Prefix, infix and postfix expressions, recursion. Queues and Queue ADT, Queue manipulation.

UNIT – II

Sparse Matrix Representation (Array and Link List representation) and arithmetic (addition, subtraction and multiplication), polynomials and polynomial arithmetic.
Trees, Properties of Trees, Binary trees, Binary Tree traversal, Tree manipulation algorithms, Expression trees and their usage, binary search trees, AVL Trees, Heaps and their implementation, Priority Queues, B-Trees, B* Tree, B+ Tree

UNIT – III

Sorting concept, order, stability, Selection sorts (straight, heap), insertion sort (Straight Insertion, Shell sort), Exchange Sort (Bubble, quicksort), Merge sort (External Sorting) (Natural merge, balanced merge and

polyphase merge). Searching – List search, sequential search, binary search, hashing methods, collision resolution in hashing.

UNIT – IV

Disjoint sets representation, union find algorithm, Graphs, Graph representation, Graph Traversals and their implementations (BFS and DFS). Minimum Spanning Tree algorithms, Shortest Path Algorithms

Textbook(s):

1. Richard Gilberg , Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C, 2nd Edition, Cengage Learning, Oct 2004
2. E. Horowitz, S. Sahni, S. Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, Silicon Press (US), 2007.

References:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson, September, 1996
2. Robert Kruse, “Data Structures and Program Design in C”, 2nd Edition, Pearson, November, 1990
3. Seymour Lipschutz, “Data Structures with C (Schaum's Outline Series)”, McGrawhill, 2017
4. A. M. Tenenbaum, “Data structures using C”. Pearson Education, India, 1st Edition 2003.
5. Weiss M.A., “Data structures and algorithm analysis in C++”, Pearson Education, 2014.

Paper Code(s): CIC-211	**L**	**P**	**C**
Paper: Object-Oriented Programming Using C++	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basic Concepts of Object Oriented Programming (data types, operators and functions) using C++
2.	To introduce concepts of Classes and Objects with the examples of C++ programming
3.	To understand object oriented features such as Inheritance and Polymorphism
4.	To use various object oriented concepts (exceptional handling) to solve different problems

Course Outcomes (CO)

CO 1	Ability to have an in-depth knowledge of object oriented programming paradigm
CO 2	To be able to develop basic C++ programming skills
CO 3	To be able to apply various object oriented features using C++
CO 4	Ability to have an understanding of generic programming & standard templates

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT – I

Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of Object Oriented Programming, Object Oriented Languages, Applications of Object Oriented Programming, C++ Programming Language, Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators in C++, Implicit Type Conversions, Operator Precedence, The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend Functions, default parameter value.

UNIT – II

Specifying a class, Member Functions, Encapsulation, information hiding, abstract data types, objects & classes, Static Member Functions, Arrays of Objects, Constructors & Destructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors, identity and behaviour of an object, C++ garbage collection, dynamic memory allocation, Explicit Type Conversions, Operator Overloading.

UNIT – III

Inheritance, inheritance methods, Class hierarchy, derivation – public, private & protected, aggregation, Inheritance Constructors, composition vs. classification hierarchies, Containership, Initialization List, Polymorphism, categorization of polymorphic techniques, polymorphism by parameter, parametric polymorphism, generic function – template function, function overriding, run time polymorphism, virtual functions.

UNIT – IV

Standard C++ classes, using multiple inheritance, persistant objects, streams and files, namespaces, exception handling, generic classes, standard template library: Library organization and containers, standard containers, algorithm and Function objects, iterators and allocators, strings, streams, manipulators, user defined manipulators, vectors.

Textbook(s):

1. Stanley B. Lippman, Josée Lajoie, Barbara E. Moo, "C++ Primer", Addison-Wesley Professional, 2012.
2. Ivor Horton, "Using the C++ Standard Template Libraries", Apress, 2015.
3. R. Lafore, "Object Oriented Programming using C++", Galgotia.

References:

1. A.R.Venugopal, Rajkumar, T. Ravishanker "Mastering C++", TMH
2. Bjarne Stroustrup, "Programming: principles and practice using C++", Addison-Wesley, 2015.
3. Bjarne Stroustrup, "A Tour of C++", Addison-Wesley Professional, 2018.
4. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley Professional, 2013.
5. Peter Van Weert and Marc Gregoire, "C++17 Standard Library Quick Reference: A Pocket Guide to Data Structures, Algorithms, and Functions", Apress (2019)
6. Rumbaugh et. al. " Object Oriented Modelling & Design", Prentice Hall
7. G . Booch "Object Oriented Design & Applications", Benjamin,Cummings.
8. E.Balaguruswamy, "Objected Oriented Programming with C++", TMH
9. Steven C. Lawlor, "The Art of Programming Computer Science with C++", Vikas Publication.
10. Slobodan Dmitrović, Modern C++ for Absolute Beginners":A Friendly Introduction to C++ Programming Language and C++11 to C++20 Standards", Apress, 2020.

Paper Code(s): ES-251	**L**	**P**	**C**
Paper: Computational Methods Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Computational Methods) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in C/C++

1. Program for finding roots of f(x)=0 Newton Raphson method.
2. Program for finding roots of f(x)=0 by bisection method.
3. Program for finding roots of f(x)=0 by secant method.
4. To implement Langrange's Interpolation formula.
5. To implement Newton's Divided Difference formula.
6. Program for solving numerical integration by Trapezoidal rule
7. Program for solving numerical integration by Simpson's 1/3 rule
8. To implement Numerical Integration Simpson 3/8 rule.
9. Inverse of a system of linear equations using Gauss-Jordan method.
10. Find the Eigen values using Power method.
11. Program for solving ordinary differential equation by Runge-Kutta Method.

Paper Code(s): ECC-253	**L**	**P**	**C**
Paper: Digital Logic and Computer Design Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Digital Logic and Computer Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design and implementation of adders and subtractors using logic gates.
2. Design and implementation of 4-bit binary adder/subtractor.
3. Design and implementation of multiplexer and demultiplexer.
4. Design and implementation of encoder and decoder.
5. Construction and verification of 4-bit ripple counter and Mod-10/Mod-12 ripple counter.
6. Design and implementation of 3-bit synchronous up/down counter.
7. Design and computer architecture: Design a processor with minimum number of instructions, so that it can do the basic arithmetic and logic operations.
8. Write an assembly language code in GNUsim8085 to implement data transfer instruction.
9. Write an assembly language code in GNUsim8085 to store numbers in reverse order in memory location.
10. Write an assembly language code in GNUsim8085 to implement arithmetic instruction.
11. Write an assembly language code in GNUsim8085 to add two 8 bit numbers.
12. Write an assembly language code in GNUsim8085 to find the factorial of a number.
13. Write an assembly language code in GNUsim8085 to implement logical instructions.
14. Write an assembly language code in GNUsim8085 to implement stack and branch instructions.

Paper Code(s): CIC-255	**L**	**P**	**C**
Paper: Data Structures Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Data Structures) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Implement sparse matrix using array. Description of program:
   a. Read a 2D array from the user.
   b. Store it in the sparse matrix form, use array of structures.
   c. Print the final array.
2. Create a linked list with nodes having information about a student and perform
   a. Insert a new node at specified position.
   b. Delete of a node with the roll number of student specified.
   c. Reversal of that linked list.
3. Create doubly linked list with nodes having information about an employee and perform Insertion at front of doubly linked list and perform deletion at end of that doubly linked list.
4. Create circular linked list having information about a college and perform Insertion at front perform Deletion at end.
5. Implement two stacks in a using single array.
6. Create a stack and perform Push, Pop, Peek and Traverse operations on the stack using Linked list.
7. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
8. Implement Experiment-2 using liked list.
9. Create a Binary Tree and perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
10. Implement insertion, deletion and traversals (inorder, preorder and postorder) on binary search tree with the information in the tree about the details of an automobile (type, company, year of make).
11. Implement Selection Sort, Bubble Sort, Insertion sort, Merge sort, Quick sort, and Heap Sort using array as a data structure.
12. Perform Linear Search and Binary Search on an array. Description of programs:
    a. Read an array of type integer.
    b. Input element from user for searching.
    c. Search the element by passing the array to a function and then returning the position of the element from the function else return -1 if the element is not found.
    d. Display the position where the element has been found.
13. Implement the searching using hashing method.
14. Create a graph and perform DFS and BFS traversals.

Paper Code(s): CIC-257	**L**	**P**	**C**
Paper: Object-Oriented Programming Using C++ Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Object-Oriented Programming Using C++) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program for multiplication of two matrices using OOP.
2. Write a program to perform addition of two complex numbers using constructor overloading. The first constructor which takes no argument is used to create objects which are not initialized, second which takes one argument is used to initialize real and imag parts to equal values and third which takes two argument is used to initialized real and imag to two different values.
3. Write a program to find the greatest of two given numbers in two different classes using friend function.
4. Implement a class string containing the following functions:
    a. Overload + operator to carry out the concatenation of strings.
    b. Overload = operator to carry out string copy.
    c. Overload <= operator to carry out the comparison of strings.
    d. Function to display the length of a string.
    e. Function tolower( ) to convert upper case letters to lower case.
    f. Function toupper( ) to convert lower case letters to upper case.
5. Create a class called LIST with two pure virtual function store() and retrieve().To store a value call store and to retrieve call retrieve function. Derive two classes stack and queue from it and override store and retrieve.
6. Write a program to define the function template for calculating the square of given numbers with different data types.
7. Write a program to demonstrate the use of special functions, constructor and destructor in the class template. The program is used to find the bigger of two entered numbers.
8. Write a program to perform the deletion of white spaces such as horizontal tab, vertical tab, space ,line feed ,new line and carriage return from a text file and store the contents of the file without the white spaces on another file.
9. Write a program to read the class object of student info such as name , age ,sex ,height and weight from the keyboard and to store them on a specified file using read() and write() functions. Again the same file is opened for reading and displaying the contents of the file on the screen.
10. Write a program to raise an exception if any attempt is made to refer to an element whose index is beyond the array size.

Paper Code(s): BS-202	L	P	C
Paper: Probability, Statistics and Linear Programming	4	-	4

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To understand probability and probability distributions.
2:	To understand methods of summarization of data.
3:	To understand and use test for hypothesis.
4:	To understand methods for solving linear programming problems.

Course Outcomes (CO):

CO1:	Ability to solve probability problems and describe probability distributions.
CO2:	Ability to describe and summarize data.
CO3:	Ability to use test for hypothesis.
CO4:	Ability to formulate and solve linear programming problems.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	3	1	1	1	-	-	-	-	-	1	2
CO2	-	3	1	1	1	-	-	-	-	-	1	2
CO3	-	3	2	2	1	-	-	-	-	-	2	2
CO4	-	3	3	3	1	-	-	-	-	-	2	2

Unit I

Basics: Probability and Statistical models, Sample Spaces and Events, Counting Techniques, Interpretations and Axioms of Probability, Unions of Events and Addition Rules, Conditional Probability, Intersections of Events and Multiplication and Total Probability Rules, Independence, Bayes' Theorem, Random Variables.
Discrete and Continuous Random Variables and Distributions: Probability Distributions and Probability Mass / density Functions, Cumulative Distribution Functions, Mean and Variance of a Random Variable, Discrete and continuous Uniform Distribution, Binomial Distribution, Geometric and Negative Binomial Distributions, Hypergeometric Distribution, Poisson Distribution. Normal Distribution, Normal Approximation to the Binomial, and Poisson Distributions; Exponential Distribution, Erlang and Gamma Distributions, Weibull Distribution, Lognormal Distribution, Beta Distribution.

Unit II

Joint Probability Distributions for Two Random Variables, Conditional Probability Distributions and Independence, Joint Probability Distributions for Two Random Variables, Covariance and Correlation, Common Joint Distributions, Linear Functions of RandomVariables, General Functions of Random Variables, Moment-Generating Functions.
Numerical Summaries of Data, Stem-and-Leaf Diagrams, Frequency Distributions and Histograms, Box Plots, Time Sequence Plots, Scatter Diagrams, Probability Plots. Point Estimation, Sampling Distributions and the Central

Limit Theorem without proof, General Concepts of Point Estimation, Methods of Point Estimation, Statistical Intervals for a Single Sample.

Unit III

Hypotheses Testing for a SingleSample: Tests on the Mean of a Normal Distribution with Variance Known / Unknown, Tests on the Variance and Standard Deviationof a Normal Distribution, Tests on a Population Proportion, Testing for Goodness of Fit, Nonparametric tests (Signed, Wilcoxon), Similarly Statistical Inference forTwo Samples.
Regression and Correlation: Linear Regression, Least Squares Estimators, Hypotheses testing for simple linear regression, Confidence Intervals, Adequacy of model, Correlation, Transformed Variables, Logistic Regression. Similarly, for multiple linear regression including aspects of MLR.

Unit IV

Linear Programming: Introduction, formulation of problem, Graphical method, Canonical and Standard form of LPP, Simplex method, Duality concept, Dual simplex method, Transportation and Assignment problem.

Textbooks:
1. *Applied Statistics and Probability for Engineers* by Douglas G. Montgomery and Runger, Wiley, 2018
2. *Linear Programming* by G. Hadley, Narosa, 2002

References:
1. *Miller and Freund's Probability and Statistics for Engineers* by Richard A. Johnson, Pearson, 10th Ed., 2018.
2. *Probability & Statistics for Engineers & Scientists* by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Pearson, 2016.
3. *Statistics and probability with applications for engineers and scientists using Minitab, R and JMP*, C. Gupta, Irwin Guttman, and Kalanka P. Jayalath, Wiley, 2020.
4. *Probability and Statistics for Engineering and the Sciences*, Jay Devore, Cengage Learning, 2014.
5. *Probability and Statistics in Emgineering*, William W. Hines, Douglas C. Montgomery, David M. Goldman, and Connie M. Borror, Wiley, 2003.
6. *Operations Research: An Introduction* by Hamdy A. Taha, Pearson, 10th Edition, 2016

Paper Code(s): HS-204	L	P	C
Paper: Technical Writing	2	-	2

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks
3. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instruction for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives:

1:	To improve grammar and sentence structure and build vocabulary.
2:	To understand how to write different types of writings.
3:	To understand how to compose different types of business documents.
4:	To understand business ethics and develop soft skills.

Course Outcomes (CO):

CO1:	Ability to improve grammar and sentence structure and build vocabulary.
CO2:	Ability to write different types of writings with clarity.
CO3:	Ability to write different types of business documents.
CO4:	Ability to apply business ethics and enhance personality.

Course Outcomes (CO to Programme Outcomes (PO) Mapping (scale 1: low, 2: Medium, 3: High

CO/PO	*PO01*	*PO02*	*PO03*	*PO04*	*PO05*	*PO06*	*PO07*	*PO08*	*PO09*	*PO10*	*PO11*	*PO12*
CO1	-	-	-	-	-	1	-	-	-	3	-	-
CO2	-	-	-	-	-	1	-	-	-	3	-	-
CO3	-	-	-	-	-	1	-	-	-	3	-	-
CO4	-	-	-	-	-	1	-	3	-	3	-	-

Unit I

Grammar and Vocabulary--- Types of sentences (simple, complex and compound) and use of connectives in sentences, Subject-verb agreement, Comprehension, Synonyms and Antonyms, Homophones and Homonyms, Word Formation: Prefixes and Suffixes, Indianism, Misappropriation and Redundant Words, Question Tags and Short Responses.

Unit II

Writing Styles -- Expository, Explanatory, Descriptive, Argumentative and Narrative.
Precis writing, Visual Aids in Technical Writing, Plagiarism and Language Sensitivity in Technical Writing, Dialogue Writing, Proposals: Purpose and Types.

Unit III

Letters at the Workplace—letter writing: Request, Sales, Enquiry, Order and Complaint.
Job Application---Resume and Cover letter, Difference between Resume and CV, Preparation for Interview.
Meeting Documentation--- Notice, Memorandum, Circular, Agenda, Office Order and Minutes of meeting, Writing Instructions.

Unit IV

Ethics and Personality Development-----The Role of Ethics in Business Communication—Ethical Principles, Time Management, Self-Analysis through SWOT and JOHARI Window, Emotional Intelligence and Leadership Skills, Team Building, Career Planning, Self Esteem.

Textbook:

1. Meenakshi Raman and Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press, New Delhi (2015).

References:

1. Sanjay Kumar and Pushp Lata, Communication Skills, Oxford University Press, New Delhi (2015).
2. Herta A Murphy, Herbert W Hildebrandt, Jane P Thomas, Effective Business Communication, Tata McGraw-Hill, Hill Publishing Company Limited, Seventh Edition.

Paper Code(s): CIC-206	**L**	**P**	**C**
Paper: Theory of Computation	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand Automata (Deterministic and Non-Deterministic) and Language Theory
2.	To understand Context Free Grammar (CFG), Parse Trees and Push Down Automata
3.	To introduce the concepts of Turing Machines and Computability Theory
4.	To understand Complexity Theory (NP-completess NP-hardness) and Space complexity

Course Outcomes (CO)

CO 1	Ability to understand the design aspects of "abstract models" of computers like finite automata, pushdown automata, and Turing machines.
CO 2	Ability to comprehend the recognizability (decidability) of grammar (language) with specific characteristics through these abstract models.
CO 3	Ability to decide what makes some problems computationally hard and others easy?
CO 4	A ability to deliberate the problems that can be solved by computers and the ones that cannot?

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	1	1	3
CO 2	3	2	2	2	2	-	-	-	2	1	1	3
CO 3	3	2	2	2	2	-	-	-	2	1	1	3
CO 4	3	2	2	2	2	-	-	-	2	1	1	3

UNIT – I

Automata and Language Theory: Chomsky Classification, Finite Automata, Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Regular Expressions, Equivalence of DFAs, NFAs and Regular Expressions, Closure properties of Regular grammar, Non-Regular Languages, Pumping Lemma.

UNIT – II

Context Free Languages: Context Free Grammar (CFG), Parse Trees, Push Down Automata (deterministic and non-deterministic) (PDA), Equivalence of CFGs and PDAs, Closure properties of CFLs, Pumping Lemma, Parsing, LL(K) grammar.

UNIT – III

Turing Machines and Computability Theory: Definition, design and extensions of Turing Machine, Equivalence of various Turing Machine Formalisms, Church – Turing Thesis, Decidability, Halting Problem, Reducibility and

its use in proving undecidability. Rices theorem. Undecidability of Posts correspondence problem., Recursion Theorem.

UNIT – IV

Complexity Theory: The class P as consensus class of tractable sets. Classes NP, co-NP. Polynomial time reductions. NP-completess, NP-hardness. Cook- Levin theorem (With proof). Space complexity, PSPACE and NPSPACE complexity classes, Savitch theorem (With proof). Probabilistic computation, BPP class. Interactive proof systems and IP class. relativized computation and oracles.

Textbook(s):

1. Sipser, Michael. Introduction to the Theory of Computation, Cengage Learning, 2012.
2. J. Hopcroft, R. Motwani, and J. Ullman, Introduction to Automata Theory, Language and Computation, Pearson, 2nd Ed, 2006.

References:

1. Peter Linz, An Introduction to Formal Languages and Automata, 6th edition, Viva Books, 2017
1. Maxim Mozgovoy, Algorithms, Languages, Automata, and Compilers, Jones and Bartlett, 2010.
2. D. Cohen, Introduction to Computer Theory, Wiley, N. York, 2nd Ed, 1996.
3. J. C. Martin, Introduction to Languages and the Theory of Computation, TMH, 2nd Ed. 2003.
4. K. L. Mishra and N. Chandrasekharan, Theory of Computer Science: Automata, Languages and Computation, PHI, 2006.
5. Anne Benoit, Yves Robert, Frédéric Vivien, A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis, CRC Press, 2013.

Paper Code(s): CIC-210	**L**	**P**	**C**
Paper: Database Management System	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce basic concepts, architecture and characteristics of database systems
2.	To introduce relational model concepts and PL/SQL programming
3.	To introduce relational database design and Normal forms based on functional dependencies
4.	To introduce concepts of object oriented & distributed databases

Course Outcomes (CO) :

CO 1	Ability to understand advantages of database systems
CO 2	Ability to use SQL as DDL, DCL and DML
CO 3	Ability to design database and manage transaction processing
CO 4	Understand object oriented & distributed databases systems and use them

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT – I

Basic concepts: database & database users, characteristics of the database systems, concepts and architecture, date models, schemas & instances, DBMS architecture & data independence, database languages & interfaces, data modelling using the entity-relationship approach. Enhanced ER concepts - Specialization/Generalization, Aggregation, Mapping of ER model to Relational Model.
SQL – DDL, DCL & DML views and indexes in SQL. Basics of SQL, DDL, DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator.

UNIT - II:

Relational model concepts, relational model constraints, relational algebra, relational calculus.
SQL – Functions - aggregate functions, Built-in functions – numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. Transaction control commands – Commit, Rollback, Save point.

UNIT - III

Relational data base design: functional dependencies & normalization for relational databases, normal forms based on functional dependencies, (1NF, 2NF, 3NF & BCNF), lossless join and dependency preserving

decomposition, normal forms based on multivalued & join dependencies (4NF & 5NF) & domain key normal form

Properties of Transaction, Transaction states, Transaction Schedule, Serializability, Concurrency control techniques, locking techniques, time stamp ordering, Recoverable schedules, granularity of data items, Deadlock detection and Recovery, recovery techniques: recovery concepts, database backup and recovery from catastrophic failures.
Database Programming – control structures, exception handling, stored procedures, Triggers.

UNIT - IV

File Structures and Indexing: Secondary Storage Devices, Operations on Files, Heap Files, Sorted Files, Hashing, Single level indexes, Multi-level indexes, B and B+ tree indexes.
Concepts of Object Oriented Database Management systems & Distributed Database Management Systems

Textbooks:
1. R. Elmsari and S. B. Navathe, "Fundamentals of database systems", Pearson Education, 7th Edition, 2018
2. V. M. Grippa and S. Kumichev, "Learning MySQL", O'Reilly, 2021.
3. SQL/ PL/SQL, The programming language of Oracle, Ivan Bayross, 4th Edition BPB Publications

References:
1. A. Silberschatz, H. F. Korth and S. Sudershan, "Database System Concept", McGraw Hill, 6th Edition,2013.
2. Date, C. J., "An introduction to database systems", 8th Edition, Pearson Education, 2008.
3. P. Rob & C. Coronel, "Database Systems: Design Implementation & Management", Thomson Learning, 6th Edition, 2004
4. Desai, B., "An introduction to database concepts", Galgotia publications, 2010
5. H. Garcia-Molina, J. D. Ullman, J. Widom, "Database System: The Complete Book", PH.
6. Joel Murach, Murach's Mysql"", 3rd Edition-Mike Murach and Associates, Incorporated, 2019.
7. Oracle and MySQL manuals.

Paper Code(s): CIC-212	**L**	**P**	**C**
Paper: Programming in Java	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand and gain knowledge of characteristics of Java, JVM, instruction set, control flow, programming and the sandbox model.
2.	To learn the Java programming, use of exceptional handling and inheritance.
3.	To understand threads, thread synchronization, AWT components and event handling mechanism.
4.	To understand the concepts of I/O streams, JDBC, object serialization, sockets, RMI, JNI, Collection API interfaces, Vector, Stack, Hash table classes, list etc.

Course Outcomes (CO)

CO 1	Ability to understand the compilation process of Java, role of JVM as an emulator and various types of instructions.
CO 2	Ability to learn and apply concepts of Java programming, exceptional handling and inheritance.
CO 3	Ability to understand the use of multi-threading, AWT components and event handling mechanism in Java.
CO 4	Ability to understand the concepts of I/O streams, IDBC, object serialization, sockets, RMI, JNI, Collection API interfaces, Vector, Stack, Hash table classes, list etc.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT - I

Overview and characteristics of Java, Java program Compilation and Execution Process Organization of the Java Virtual Machine, JVM as an interpreter and emulator, Instruction Set, class File Format, Verification, Class Area, Java Stack, Heap, Garbage Collection. Security Promises of the JVM, Security Architecture and Security Policy. Class loaders and security aspects, sandbox model

UNIT - II

Java Fundamentals, Data Types & Literals Variables, Wrapper Classes, Arrays, Arithmetic Operators, Logical Operators, Control of Flow, Classes and Instances, Class Member Modifiers Anonymous Inner Class Interfaces and Abstract Classes, inheritance, throw and throws clauses, user defined Exceptions, The String Buffer Class, tokenizer, applets, Life cycle of applet and Security concerns.

UNIT - III

Threads: Creating Threads, Thread Priority, Blocked States, Extending Thread Class, Runnable Interface, Starting Threads, Thread Synchronization, Synchronize Threads, Sync Code Block, Overriding Synced Methods, Thread Communication, wait, notify and notify all.
AWT Components, Component Class, Container Class, Layout Manager Interface Default Layouts, Insets and Dimensions, Border Layout, Flow Layout, Grid Layout, Card Layout Grid Bag Layout AWT Events, Event Models, Listeners, Class Listener, Adapters, Action Event Methods Focus Event Key Event, Mouse Events, Window Event

UNIT - IV

Input/Output Stream, Stream Filters, Buffered Streams, Data input and Output Stream, Print Stream Random Access File, JDBC (Database connectivity with MS-Access, Oracle, MS-SQL Server), Object serialization, Sockets, development of client Server applications, design of multithreaded server. Remote Method invocation, Java Native interfaces, Development of a JNI based application.
Collection API Interfaces, Vector, stack, Hashtable classes, enumerations, set, List, Map, Iterators.

Textbook(s):
1. Patrick Naughton and Herbertz Schidt, “Java-2 the Complete Reference”,TMH

References:
1. E. Balaguruswamy, “Programming with Java”, TMH
2. Horstmann, “Computing Concepts with Java 2 Essentials”, John Wiley.
3. Decker & Hirshfield, “Programming Java”, Vikas Publication.

Paper Code(s): BS-252	**L**	**P**	**C**
Paper: Probability, Statistics and Linear Programming Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Probability, Statistics and Linear Programming) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

Implementation to be done in MATLAB or in equivalent software.

1. Installation of Scilab and demonstration of simple programming concepts like marix multiplication (scalar and vector), loop, conditional statements and plotting.

2. Program for demonstration of theoretical probability limits.

3. Program to plot normal distributions and exponential distributions for various parametric values.

4. Fitting of binomial distributions for given n and p.

5. Fitting of binomial distributions after computing mean and variance.

6. Fitting of Poisson distributions for given value of lambda.

7. Fitting of Poisson distributions after computing mean.

8. Fitting of normal distribution when parameters are given.

9. Fitting of linear regression line through given data set and testing of goodness of fit using mean error.

10. Fitting of Multiple Linear Regression (MLR) curve through given data set and testing of goodness of fit using mean error.

11. Solve a LPP of three variable using Simplex Method.

12. Solve a Transportation problem of three variables.

13. Solve an Assignment problem of three variables.

Paper Code(s): CIC-256	**L**	**P**	**C**
Paper: Database Management System Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Database Management System) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Experiments based on DDL commands – CREATE, ALTER, DROP and TRUNCATE.
2. Apply the integrity constraints like Primary Key, Foreign key, Check, NOT NULL, etc. to the tables.
3. Experiments based on basic DML commands – SELECT, INSERT, UPDATE and DELETE.
4. Write the queries for implementing Built-in functions, GROUP BY, HAVING and ORDER BY.
5. Write the queries to implement the joins.
6. Write the queries to implement the subqueries.
7. Write the queries to implement the set operations.
8. Write the queries to create the views and queries based on views.
9. Demonstrate the concept of Control Structures.
10. Demonstrate the concept of Exception Handling.
11. Demonstrate the concept of Functions and Procedures.
12. Demonstrate the concept of Triggers.

Paper Code(s): CIC-258	**L**	**P**	**C**
Paper: Programming in Java Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Programming in Java) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a java program to implement stack and queue concept.
2. Write a java program to produce the tokens from given long string.
3. Write a java package to show dynamic polymorphism and interfaces.
4. Write a java program to show multithreaded producer and consumer application.
5. Create a customized exception and also make use of all the 5 exception keywords.
6. Convert the content of a given file into the uppercase content of the same file.
7. Write a program in java to sort the content of a given text file.
8. Develop an analog clock using applet.
9. Develop a scientific calculator using swings.
10. Create an editor like MS-word using swings.
11. Create a servlet that uses Cookies to store the number of times a user has visited your servlet.
12. Create a simple java bean having bound and constrained properties.

Paper Code(s): EEC-253 / EEC-254	**L**	**P**	**C**
Paper: Circuits and Systems Lab	**-**	**2**	**1**

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Circuits and Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to MATLAB and its basic commands.
2. Plot unit step, unit impulse, unit ramp, exponential, parabolic functions and sinusoidal signals
3. Plot the linear convolution of two sequences
4. Study the transient response of series RLC circuit for different types of waveforms on CRO and verify using MATLAB
5. Study the time response of a simulated linear system and verify the unit step and square wave response of first order and second order, type 0,1 system
6. To determine Z and Y parameters of the given two port network.
7. To determine ABCD parameters of the given two port network.
8. To verify various theorems in AC Circuits.
9. To determine Hybrid parameters of the given two port network.
10. To design Cascade Connection and determine ABCD parameters of the given two port network.
11. To design Series-Series Connection and determine Z parameters of the given two port network.
12. To design Parallel-Parallel Connection and determine Y parameters of the given two port network.
13. To design Series-Parallel Connection and determine h parameters of the given two port network.

Economics for Engineers	L	P	C
	2		2

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	5	HS/MS	HS	HS-301

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain the basic micro and macro economics concepts.
2.	To analyze the theories of production, cost, profit and break even analysis.
3.	To evaluate the different market structures and their implications for thebehavior of the firm.
4.	To apply the basics of national income accounting and business cycles toIndian economy.

Course Outcomes (CO)

CO 1	Analyze the theories of demand, supply, elasticity and consumer choicein the market.
CO 2	Analyze the theories of production, cost, profit and break even analysis.
CO 3	Evaluate the different market structures and their implications for thebehavior of the firm.
CO 4	Apply the basics of national income accounting and business cycles toIndian economy.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	2	1	2	1	-	1	-	1	1	3	1
CO 2	1	2	1	2	1	-	1	-	1	1	3	1
CO 3	1	2	1	2	1	-	1	-	1	1	3	1
CO 4	1	2	1	2	1	-	1	-	1	1	3	1

UNIT-I

Introduction: Economics Definition, Basic economic problems, Resource constraints and welfare maximization. Microand Macro economics. Production Possibility Curve.Circular flow of economic activities.
Basics of Demand, Supply and Equilibrium: Demand side and supply side of the market. Factors affecting demand & supply. Elasticity of demand & supply – price, income and cross-price elasticity. Market equilibrium price.

UNIT-II

Theory of Consumer Choice: Theory of Utility and consumer's equilibrium.Indifference Curve analysis, Budget Constraints, Consumer Equilibrium.
Demand forecasting: Regression Technique, Time-series, Smoothing Techniques: Exponential, Moving AveragesMethod

UNIT-III

Cost Theory and Analysis: Nature and types of cost, Cost functions- short run and long run, Economies and diseconomies of scale
Market Structure: Market structure and degree of competitionPerfect competition, Monopoly, Monopolistic competition, Oligopoly

UNIT - IV

National Income Accounting: Overview of Macroeconomics, Basic concepts of NationalIncome Accounting
Macro Economics Issues: Introduction to Business Cycle, Inflation-causes,consequences and remedies: Monetary and Fiscal policy.

Textbook(s):
1. H.C. Petersen, W.C. Lewis, Managerial Economics, 4th ed., Pearson Education 2001.

References:
1. S.K. Misra& V. K. Puri, Indian Economy, 38th ed., Himalaya Publishing House, 2020.
2. D.N. Dwivedi, Managerial Economics, 8th Edition, Vikas Publishing house
3. D. Salvatore, Managerial Economics in a Global Economy, 8th ed., Oxford University Press, 2015.
4. S. Damodaran, Managerial Economics, 2 nd ed., Oxford University Press, 2010.
5. M. Hirschey, Managerial Economics, 12th ed., Cengage India, 2013.
6. P.A. Samuelson, W.D. Nordhaus, S. Nordhaus,Economics,18th ed., Tata Mc-Graw Hill, 2006.

Compiler Design	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-303

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	introduce the major concept areas of language translation and compiler design.
2.	To enrich the knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table.
3.	To extend the knowledge of parser by parsing LL parser and LR parser.
4.	To provide practical programming skills necessary for constructing a compiler.

Course Outcomes (CO)

CO 1	Able to apply the knowledge of LEX tool & YACC tool to develop a scanner & parser.
CO 2	Able to design & implement a software system for backend of the compiler.
CO 3	Able to design syntax tree and intermediate code generator.
CO 4	To understand the concept of symbol table and to use various code optimization techniques

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	-	2	3	2	-	-	-	-	-	3
CO 2	3	2	-	2	3	2	-	-	-	-	-	3
CO 3	3	2	-	2	3	2	-	-	-	-	-	3
CO 4	3	2	-	2	3	2	-	-	-	-	-	3

UNIT-I

Compilers and translators, need of translators, structure of compiler: its different phases, compiler construction tools, Lexical analysis: Role of lexical analyzer, Input Buffering, A simple approach to the design of Lexical Analyzers, Specification and recognition of tokens, Finite automata, From regular expressions to automata, and vice versa, minimizing number of states of DFA, A language for specifying Lexical Analyzers, Design and implementation of lexical analyzer.

UNIT-II

The role of the parser, Context free grammars, Writing a grammar: Lexical versus Syntactic analysis, Eliminating ambiguity, Elimination of left recursion, Left factoring, Top Down Parsing: Recursive- Decent parsing, Non-recursive Predictive parsing, LL(1) grammars, Bottom Up Parsing: Shift Reduce Parsing, Operator precedence parsing, LR Parsing: SLR, LALR and Canonical LR parser, Parser Generators.

UNIT-III

Syntax Directed Translation: Syntax directed definitions, Evaluation orders for SDD's, construction of syntax trees, syntax directed translation schemes, implementation of syntax directed translation,
Intermediate Code Generation: Kinds of intermediate code: Postfix notation, Parse trees and syntax trees, Three-address code, quadruples and triples, Semantic Analysis: Types and Declarations, Translation of Expressions, Type checking.

UNIT - IV

Symbol Table: Symbol tables, its contents, Data Structure for Symbol Table: lists, trees, linked lists, hash tables, Error Detection and Recovery: Errors, lexical phase errors, syntactic phase errors, semantic errors, Error seen by each phase.
Code Optimization: The principal sources of optimizations, Loop optimization, Basic blocks and Flow Graphs, DAG representation of basic blocks, Code Generation: Issues in the design of code generation, A simple target machine mode, A Simple Code Generator, Peep-hole optimization, Register allocation and assignment.

Textbook(s):

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, "Compilers Principle, Techniques, and Tool", Pearson.
2. Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman, "Compilers Principle, Techniques, and Tool", Addison Wesley.

References:

1. Trembley and Sorenson, "Theory and Practice of Compiler Writing", McGraw Hill.
2. Jhon R. Levine, Tony Mason and Doug Brown, —Lex &Yacc, O'Reilly.
3. M. Joseph, "Elements compiler Design", University Science Press.

Compiler Design Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-351

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Compiler Design) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Practice of LEX/YACC of compiler writing.
2. Write a program to check whether a string belong to the grammar or not.
3. Write a program to check whether a string include Keyword or not.
4. Write a program to remove left Recursion from a Grammar.
5. Write a program to perform Left Factoring on a Grammar.
6. Write a program to show all the operations of a stack.
7. Write a program to find out the leading of the non-terminals in a grammar.
8. Write a program to Implement Shift Reduce parsing for a String.
9. Write a program to find out the FIRST of the Non-terminals in a grammar.
10. Write a program to check whether a grammar is operator precedent.

Computer Networks	**L**	**P**	**C**
	4		**4**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-307
ICE	5	PC	PC	CIC-313

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	ild an understanding of the fundamental concepts of computer networking.
2.	Familiarize the student with the basic taxonomy and terminology of the computer networking area.
3.	Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
4.	Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes (CO)

CO 1	Understand basic computer network technology.
CO 2	Understand and explain Data Communications System and its components.
CO 3	Implements various network topologies and IP addressing, subnetting.
CO 4	Enumerate the layers of the OSI model and TCP/IP.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	1	1	3	1	-	-	-	-	-	3
CO 2	3	2	1	1	3	1	-	-	-	-	-	3
CO 3	3	2	1	1	3	1	-	-	-	-	-	3
CO 4	3	2	1	1	3	1	-	-	-	-	-	3

UNIT-I

Data Communications: Components, Networks, The Internet, Protocols and Standards, Network Models: The OSI Model, TCP/IP Protocol Suite , A Comparison of the OSI and TCP/IP Reference Models, Addressing, Physical Layer: Analog and Digital Signals, Transmission modes, Transmission Media: Guided Media, Unguided Media, Review of Error Detection and Correction codes.

Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching.

UNIT-II

Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to –Point Access: PPP Point –to-Point Protocol, PPP Stack,
Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high-speed LANs, Token ring, Token Bus, FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

UNIT-III

Network Layer: Design issues, Routing algorithms, Congestion control algorithms, Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6.

UNIT - IV

Transport Layer: Process to Process Delivery: UDP; TCP, congestion control and Quality of service. Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), file transfer (FTP), HTTP and WWW.

Textbook(s):

1. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw-Hill.

References:

1. A. S. Tannenbum, D. Wetherall,, “Computer Networks”, Prentice Hall, Pearson.
2. Fred Halsall, “Computer Networks”, Addison – Wesley.
3. Tomasi, “Introduction To Data Communications & Networking”, Pearson.

Computer Networks Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-355
ICE	5	PC	PC	CIC-365

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Computer Networks) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to Networking Simulation Tools: Wireshark, Cisco Packet Tracer.
2. To understand the operation of TELNET by accessing the router in server room from a PC in IT office.
3. To implement an IP Addressing Scheme and Subnetting in small networks using Cisco Packet Tracer.
4. To implement the static routing using Cisco Packet Tracer.
5. To implement the DHCP onto the Network Topology using Cisco Packet Tracer.
6. To implement the DNS, Email Services in the Network using Cisco Packet Tracer.
7. To implement the Dynamic Routing Protocols: RIP, IGRP using Cisco Packet Tracer.
8. To construct multiple router networks and implement the EIGRP Protocol.
9. To implement the Network Address Resolution (NAT) using Cisco Packet Tracer.
10. Conducting a Network Capture and Monitoring with Wireshark Simulation Tool.

Design and Analysis of Algorithm	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-311

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To Introduce various designing techniques and methods for algorithms
2.	Performance analysis of Algorithms using asymptotic and empirical approaches
3.	Demonstrate a familiarity with major algorithms and data structures.
4.	To give clear idea on algorithmic design paradigms like Divide-and-Conquer, Dynamic Programming, Greedy, Branch & Bound, Back tracking and string matching and network flow. .

Course Outcomes (CO)

CO 1	Analyse asymptotic runtime complexity of algorithms including formulating recurrence relations and divide and conquer designing method.
CO 2	Describe the greedy paradigm and apply Greedy strategy for solving various problems.
CO 3	Apply dynamic programming and Branch & Bound approach to solve suitable problems
CO 4	Understand the concept of NP problems and string matching algorithm and various flow & sorting networks

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	1	1	1	1	1	2	2	2	2	1	1	1
CO 2	2	2	3	1	2	3	1	2	3	1	2	2
CO 3	2	2	1	1	2	3	3	2	1	3	1	2
CO 4	3	2	2	3	2	1	3	2	1	1	2	3

UNIT-I

Asymptotic notations for time and space complexity, Methods for solving Recurrence relations, Brief Review of Graphs, Sets and disjoint sets, union, sorting and searching algorithms and their analysis in terms of space and time complexity.

Divide and Conquer: General method, binary search, merge sort, Quick sort, selection sort, Strassen's matrix multiplication algorithms and analysis of algorithms for these problems.

UNIT-II

Greedy Method: General method, knapsack problem, Huffman Codes, job sequencing with deadlines, minimum spanning trees, single souce paths and analysis of these problems.

Back Tracking: General method, 8 queen's problem, graph colouring, Hamiltonian cycles, and analysis of these problems.

UNIT-III

Dynamic Programming: Ingredients of Dynamic Programming. Matrix Chain Multiplication, Longest common subsequence and optimal binary search trees problems, 0-1 knapsack problem, Traveling salesperson problem, Floyd Warshall algorithm.
Branch and Bound: Method, O/I knapsack and traveling salesperson problem

UNIT - IV

String Matching: The naïve String Matching algorithm, The Rabin-Karp Algorithm, String Matching with finite automata, The Knuth-Morris Pratt algorithm.
Computational Complexity: Basic Concepts, Polynomial vs Non-Polynomial Complexity, NP- hard & NP-complete classes. Approximation Algorithms
Flow and Sorting Network:, Ford- Fulkerson method, Maximum bipartite matching, Sorting Networks, Comparison network, Zero- one principle, Bitonic sorting network, merging network

Textbook(s):

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford Stein, Introduction to Algorithms, 3rd Ed., PHI, 2013.
2. Udit Aggarwal, Algorithm Design and Analysis, Dhanpat Rai and Co.

References:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Computer Algorithms/C++, Second Edition, Universities Press.
2. Jon Klenberg, Eva Tardos, Algorithm Design, Pearson Publications,2014.
3. A. V. Aho, J. E. Hopcroft, J. D. Ullman, The Design and Analysis of Computer Algorithms, Pearson, 2013.
4. Richard Neapolitan, Foundations of Algorithms, Fifth Edition, Jones & Bartlett Learning
5. Sara Base, Introduction to Design & analysis,Pearson

Design and Analysis of Algorithm Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-359

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Design and Analysis of Algorithm) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. To implement following algorithm using array as a data structure and analyse its time complexity.
   a) Merge sort
   b) Quick sort
   c) Bubble sort
   d) Selection sort
   e) Heap sort
2. To implement Linear search and Binary search and analyse its time complexity.
3. To implement Huffman Coding and analyse its time complexity.
4. To implement Minimum Spanning Tree and analyse its time complexity.
5. To implement Dijkstra‘s algorithm and analyse its time complexity.
6. To implement Bellman Ford algorithm and analyse its time complexity.
7. Implement N Queen's problem using Back Tracking.
8. To implement Matrix Multiplication and analyse its time complexity.
9. To implement Longest Common Subsequence problem and analyse its time complexity.
10. To implement naïve String Matching algorithm, Rabin Karp algorithm and Knuth Morris Pratt algorithm and analyse its time complexity.
11. To implement Sorting Network.

Paper Code(s): ES-201	**L**	**P**	**C**
Paper: Computational Methods	**4**	**-**	**4**

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand numerical methods to find roots of functions and first order unconstrained minimization of functions.
2.	To introduce concept of interpolation methods and numerical integration.
3.	To understand numerical methods to solve systems of algebraic equations and curve fitting by splines.
4.	To understand numerical methods for the solution of Ordinary and partial differential equations.

Course Outcomes (CO)

CO 1	Ability to develop mathematical models of low level engineering problems
CO 2	Ability to apply interpolation methods and numerical integration.
CO 3	Ability to solve simultaneous linear equations and curve fitting by splines
CO 4	Ability to numerically solve ordinary differential equations that are initial value or boundary value problems

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	2	2	3
CO 2	3	2	2	2	2	-	-	-	2	2	2	3
CO 3	3	3	3	3	2	-	-	-	2	2	2	3
CO 4	3	3	3	3	2	-	-	-	2	2	2	3

UNIT-I

Review of Taylor Series, Rolle 's Theorem and Mean Value Theorem, Approximations and Errors in numerical computations, Data representation and computer arithmetic, Loss of significance in computation
Location of roots of equation: Bisection method (convergence analysis and implementation), Newton Method (convergence analysis and implementation), Secant Method (convergence analysis and implementation). Unconstrained one variable function minimization by Fibonacci search, Golden Section Search and Newton's method. Multivariate function minimization by the method of steepest descent, Nelder- Mead Algorithm.

UNIT-II

Interpolation: Assumptions for interpolation, errors in polynomial interpolation, Finite differences, Gregory-Newton's Forward Interpolation, Gregory-Newton's backward Interpolation, Lagrange's Interpolation, Newton's divided difference interpolation
Numerical Integration: Definite Integral, Newton-Cote's Quadrature formula, Trapezoidal Rule, Simpson's one-third rule, simpson's three-eight rule, Errors in quadrature formulae, Romberg's Algorithm, Gaussian Quadrature formula.

UNIT-III

System of Linear Algebraic Equations: Existence of solution, Gauss elimination method and its computational effort, concept of Pivoting, Gauss Jordan method and its computational effort, Triangular Matrix factorization methods: Dolittle algorithm, Crout's Algorithm, Cholesky method, Eigen value problem: Power method Approximation by Spline Function: First-Degree and second degree Splines, Natural Cubic Splines, B Splines, Interpolation and Approximation

UNIT - IV

Numerical solution of ordinary Differential Equations: Picard's method, Taylor series method, Euler's and Runge-Kutta's methods, Predictor-corrector methods: Euler's method, Adams-Bashforth method, Milne's method.
Numerical Solution of Partial Differential equations: Parabolic, Hyperbolic, and elliptic equations
Implementation to be done in C/C++

Textbook(s):
1. E. Ward Cheney & David R. Kincaid , "Numerical Mathematics and Computing" Cengage; 7th ed (2013).

References:
1. R. L. Burden and J. D. Faires, "Numerical Analysis", CENGAGE Learning Custom Publishing; 10th Edition (2015).
2. S. D. Conte and C. de Boor, "Elementary Numerical Analysis: An Algorithmic Approach", McGraw Hill, 3rd ed. (2005).
3. H. M. Antia, "Numerical Methods for Scientists & Engineers", Hindustan Book Agency, (2002).
4. E Balagurusamy "Numerical Methods" McGraw Hill Education (2017).

Processes: Introduction, Process states, process management, Interrupts, Interprocess Communication Threads: Introduction, Thread states, Thread Operation, Threading Models. Processor Scheduling: Scheduling levels, preemptive vs no preemptive scheduling, priorities, scheduling objective, scheduling criteria, scheduling algorithms, demand scheduling, real time scheduling.

UNIT-II

Process Synchronization: Mutual exclusion, software solution to Mutual exclusion problem, hardware solution to Mutual exclusion problem, semaphores, Critical section problems. Case study on Dining philosopher problem, Barber shop problem etc.
Memory Organization & Management: Memory Organization, Memory Hierarchy, Memory Management Strategies, Contiguous versus non- Contiguous memory allocation, Partition Management Techniques, Logical versus Physical Address space, swapping, Paging, Segmentation, Segmentation with Paging Virtual Memory: Demand Paging, Page Replacement, Page-replacement Algorithms, Performance of Demand Paging, Thrashing, Demand Segmentation, and Overlay Concepts.

UNIT-III

Deadlocks: examples of deadlock, resource concepts, necessary conditions for deadlock, deadlock solution, deadlock prevention, deadlock avoidance with Bankers algorithms, deadlock detection, deadlock recovery.
Device Management: Disk Scheduling Strategies, Rotational Optimization, System Consideration, Caching and Buffering.

UNIT - IV

File System: Introduction, File Organization, Logical File System, Physical File System, File Allocation strategy, Free Space Management, File Access Control, Data Access Techniques, Data Integrity Protection, Case study on file system viz FAT32, NTFS, Ext2/Ext3 etc.

Textbook(s):

1. Deitel & Dietel, “Operating System”, Pearson, 3 rd Ed., 2011
2. Silbersachatz and Galvin, “Operating System Concepts”, Pearson, 5th Ed., 2001
3. Madnick & Donovan, “Operating System”, TMH,1st Ed., 2001

References:

1. Tannenbaum, “Operating Systems”, PHI, 4th Edition, 2000
2. Godbole, “Operating Systems”, Tata McGraw Hill, 3rd edition, 2014
3. Chauhan, “Principles of Operating Systems”, Oxford Uni. Press, 2014
4. Dhamdhere, “Operating Systems”, Tata McGraw Hill, 3rd edition, 2012
5. Loomis, “Data Management & File Structure”, PHI, 2nd Ed.

Operating Systems Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-353

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Operating Systems) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a program to implement CPU scheduling for first come first serve.
2. Write a program to implement CPU scheduling for shortest job first.
3. Write a program to perform priority scheduling.
4. Write a program to implement CPU scheduling for Round Robin.
5. Wite a program for page replacement policy using a) LRU b) FIFO c) Optimal.
6. Write a program to implement first fit, best fit and worst fit algorithm for memory management.
7. Write a program to implement reader/writer problem using semaphore.
8. Write a program to implement Producer-Consumer problem using semaphores.
9. Write a program to implement Banker's algorithm for deadlock avoidance.
10. Write C programs to implement the various File Organization Techniques

Software Engineering	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-309

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the basic concepts of the software development processes, Software requirements and specifications
2.	To impart knowledge of Software Project Planning and various Software design techniques for developing large software systems.
3.	To understand Software Metrics, Software Reliability, and Quality assurance using ISO 9001 and SEI-CMM.
4.	To impart the knowledge and use of software engineering processes and tools in analysis, design, implementation, software testing, documentation, and maintenance for software systems.

Course Outcomes (CO)

CO 1	Ability to have an understanding of SDLC Models, Techniques for Requirement Elicitation, and SRS Document.
CO 2	To be able to explain Software Project Planning and various methods for software design
CO 3	To Understand Software Metrics, Software Reliability, and Quality assurance
CO 4	Ability to have an understanding of Software testing, documentation and maintenance.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Introduction: Introduction to Software Engineering, Importance of software engineering as a discipline, Software applications, Software Crisis, Software Processes & Characteristics, Software life cycle models, Waterfall, Prototype, Evolutionary and Spiral Models.

Software Requirements Analysis & Specifications: Requirement engineering, Functional and non-functional requirements, User requirements, System requirements, requirement elicitation techniques like FAST, QFD & Use case approach, requirements analysis using DFD, Data dictionaries & ER Diagrams, Requirements documentation, Nature of SRS, Characteristics & organization of SRS, Requirement Management, IEEE Std. for SRS.

UNIT-II

Software Project Planning: Size Estimation like lines of Code & Function Count, Cost Estimation Models, COCOMO, Putnam resource allocation model, Validating Software Estimates, Risk Management.
Software Design: Cohesion & Coupling, Classification of Cohesiveness & Coupling, Function Oriented Design, Object Oriented Design, User Interface Design.

UNIT-III

Software Metrics: Software measurements: What & Why, Token Count, Halstead Software Science Measures, Data Structure Metrics, Information Flow Metrics.
Software Reliability: Importance, Hardware Reliability & Software Reliability, Failure and Faults, Reliability Models- Basic Model, Logarithmic Poisson Model, Software Quality Models, CMM & ISO 9001.

UNIT – IV

Software Testing: Testing process, Functional testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing: Path testing, Data flow and mutation testing, unit testing, integration and system testing, Debugging, Testing Tools & Standards.
Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Regression Testing, Reverse Engineering, Software Re-engineering, Configuration Management, Documentation.

Textbook(s):
1. K. K. Aggarwal and Yogesh Singh, “Software Engineering”, New Age International, 3rd Ed., 2005.
2. R. S. Pressman, “Software Engineering – A Practitioner's Approach”, McGraw Hill Int. , 5th Ed., 2001.
3. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Narosa, 3rd Ed., 2005.

References:
1. Stephen R. Schach, “Classical & Object Oriented Software Engineering”, IRWIN, 1996.
2. James Peter, W. Pedrycz, “Software Engineering: An Engineering Approach”, John Wiley & Sons.
3. I. Sommerville, “Software Engineering”, Addison Wesley,8th Ed., 2009.
4. Frank Tsui and Orlando Karan, “Essentials of Software Engineering”, Joes and Bartlett, 2nd Ed., 2010.
5. Kassem A. Saleh, “Software Engineering”, Cengage Learning, 2009.
6. Rajib Mall, “Fundamrntal of Software Engineering”, PHI, 3rd Ed., 2009.
7. Carlo Ghizzi, Mehdi Jazayeri and Dino Mandrioli, “Fundamental of Software Engineering”, PHI, 2nd Ed., 2003.
8. Carol L. Hoover, Mel Rosso-Llopart and Gil Taran, “Evaluating Project Decision Case Studies in Software Engineering”, Pearson, 2010.

Software Engineering Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	5	PC	PC	CIC-357

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Software Engineering) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write down the problem statement for a suggested system of relevance.
2. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
3. To perform the function oriented diagram: Data Flow Diagram (DFD) and Structured chart.
4. Draw the entity relationship diagram for the suggested system.
5. To perform the user's view analysis for the suggested system: Use case diagram.
6. To draw the structural view diagram for the system: Class diagram, object diagram.
7. To draw the behavioral view diagram: State-chart diagram, Activity diagram
8. To perform the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram
9. To perform the implementation view diagram: Component diagram for the system.
10. To perform the environmental view diagram: Deployment diagram for the system.
11. To perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.
12. Perform Estimation of effort using FP Estimation for chosen system.
13. To prepare time Line Chart / Gantt Chart / PERT Chart for selected software project.

Artificial Intelligence	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-374T
ECE	6	PCE	PCE-1	ECE-318T
CSE-AI/CSE-AIML	6	PC	PC	AI-302T
EAE	6	AI-EAE	AI-EAE-1	AI-302T
EAE	6	AIML-EAE	AIML-EAE-1	AI-302T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart the definition and basic knowledge of Artificial Intelligence.
2.	To introduces AI by examining the nature of the difficult problems.
3.	To understand with AI demonstration that intelligence requires ability to find reason.
4.	To understand the latest techniques and the future scope of the technology.

Course Outcomes (CO)

CO 1	Ability to use AI methods and control strategies to solve the problems.
CO 2	Understand the production system and its applications. Also, to understand the properties and applications for the different search algorithms.
CO 3	Applying the different algorithms and the techniques, also analyse the reason for the results.
CO 4	Study the expert systems and the modern approaches.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	-	-	-	-	2
CO 2	3	3	3	3	3	2	2	-	-	-	-	2
CO 3	3	3	3	3	3	2	2	-	-	-	-	2
CO 4	3	3	3	3	3	2	2	-	-	-	-	2

UNIT-I

AI Definition, Problems, The Foundations of Artificial Intelligence, Techniques, Models, Defining Problem as a state space search, production system, Intelligent Agents: Agents and Environments, Characteristics, Search methods and issues in the design of search problems.

UNIT-II

Knowledge representation issues, mapping, frame problem. Predicate logic, facts in logic, representing instance and Isa relationship, Resolution, procedural and declarative knowledge, matching, control knowledge. Symbolic reasoning under uncertainty, Non monotonic reasoning, statistical reasoning.

UNIT-III

Game Playing, minimax search, Alfa beta cut-offs, Natural Language Processing, Learning, Explanation-based learning, discovery, analogy, Neural net learning and Genetic Learning.

UNIT - IV

Fuzzy logic systems, Perception and action, Expert systems, Inference in Bayesian Networks, K-means Clustering Algorithm, Machine learning.

Textbook(s):

1. Elaine Rich, Kevin Knight, and Shivashankar B Nair, “Artificial Intelligence”, Tata McGraw Hill.
2. S. Russel and P. Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Edu.

References:

1. Deepak Khemani, “A First Choice in Artificial Intelligence”, McGraw Hill.
2. K M Fu, “Neural Networks in Computer Intelligence”, McGraw Hill.

Artificial Intelligence Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-374P
ECE	6	PCE	PCE-1	ECE-318P
CSE-AI/CSE-AIML	6	PC	PC	AI-302P
EAE	6	AI-EAE	AI-EAE-1	AI-302P
EAE	6	AIML-EAE	AIML-EAE-1	AI-302P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Artificial Intelligence) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Study of PROLOG.
2. Write simple fact for the statements using PROLOG
   a. Ram likes mango.
   b. Seema is a girl.
   c. Bill likes Cindy.
   d. Rose is red.
   e. John owns gold.
3. Write predicates, one converts centigrade temperatures to Fahrenheit, the other checksif a temperature is below freezing using PROLOG.
4. Write a program to implement Breath First Search Traversal.
5. Write a program to implement Water Jug Problem.
6. Write a program to remove punctuations from the given string.
7. Write a program to sort the sentence in alphabetical order.
8. Write a program to implement Hangman game using python.
9. Write a program to implement Hangman game.
10. Write a program to implement Tic-Tac-Toe game.
11. Write a program to remove stop words for a given passage from a text file using NLTK.
12. Write a program to implement stemming for a given sentence using NLTK.
13. Write a program to POS (part of speech) tagging for the give sentence using NLTK.
14. Write a program to implement Lemmatization using NLTK.
15. Write a program for Text Classification for the given sentence using NLTK.

Database Modelling and Design	L	P	C
	4		4

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
IT	6	PCE	PCE-1	CIE-316

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the database design life cycle and design conceptual model of database system.
2.	To design logical model of database system.
3.	To physically implement the database.
4.	To understand the need of database tuning and security.

Course Outcomes (CO)

CO 1	Able to understand the database design life cycle and design conceptual model of database system.
CO 2	Able to design logical model of database system.
CO 3	Able to physically implement the database.
CO 4	Able to perform database tuning.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	2	2	2	-	-	-	3	2	2	3
CO 2	3	3	2	2	2	-	-	-	3	2	2	3
CO 3	3	3	2	3	3	-	-	-	3	2	2	3
CO 4	3	3	2	3	3	-	-	-	3	2	2	3

UNIT-I

Introduction: Overview of database systems architecture and components, database design life cycle
Conceptual data modelling: ER Modeling, EER Modeling, Modeling complex relationships, Design issues in ER & EER modeling

UNIT-II

Logical data modelling: Overview of relational data model, Integrity constraints, Mapping ER Model to a logical schema, Mapping EER Model to a logical schema, Mapping of higher degree relationships, Mapping of Aggregation, Mapping complex ER Model Constructs to a logical schema
Normalization: Introduction, Anomalies, Normal forms – 1NF, 2NF, 3NF, BCNF, 4NF & 5NF

UNIT-III

Database implementation and physical database design: Database creation using SQL, SQL commands – DDL & DML; Views; Advanced data manipulation using SQL
Database Programming: Cursor, Exception Handling, Procedures, Functions, Packages, Triggers

UNIT - IV

Database tuning and maintenance: Introduction, Clustering and indexing, guidelines for index selection, de-normalization, database tuning
Database security: Introduction, Access control DCL Commands, views

Textbook(s):

1. Database Modelling and Database Design. Narayan S. Umanath and Richard W. Scamell. Cengage Learning, 2nd Edition.
2. Database Management Systems. Raghu Ramakrishnana and Johannes Gehrke, Mc Graw Hill, 3rd Edition.

References:

1. Database Modelling and Design. Toby Teorey, Sam Lightstone, Tom Nadeau and H. V. Jagadish. Morgan Kaufmann Publishers, 5th Edition
2. Elmasri, Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education, India.
3. Database System Concepts, Silberschatz, Korth, McGraw hill, V edition.

Principles of Management for Engineers	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	6	HS/MS	MS	MS-302

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To describe the functions, roles and skills of managers and illustrate how the manager's job is evolving.
2.	To evaluate approaches to goal setting, planning and organizing in a variety of circumstances.
3.	To evaluate contemporary approaches for staffing and leading in an organization
4.	To analyze contemporary issues in controlling for measuring organizational performance.

Course Outcomes (CO)

CO 1	Examine the relevance of the political, legal, ethical, economic andcultural environments in global business
CO 2	Evaluate approaches to goal setting, planning and organizing in a variety of circumstances.
CO 3	Evaluate contemporary approaches for staffing and leading in an organization
CO 4	Analyze contemporary issues in controlling for measuring organizational performance.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	1	2	-	2	-	-	1	2	3	2
CO 2	2	2	1	2	-	2	-	-	1	2	3	2
CO 3	2	2	1	2	-	2	-	-	1	2	3	2
CO 4	2	2	1	2	-	2	-	-	1	2	3	2

UNIT-I

Introduction to Managers and Management: Management an Overview: Introduction, Definition ofManagement, Role of Management, Functions of Managers,Levels of Management, Management Skills andOrganizational Hierarchy, Social and EthicalResponsibilities of Management: Arguments for and againstSocial Responsibilities of Business, Social Stakeholders,Measuring Social Responsiveness and Managerial Ethics,Omnipotent and Symbolic View, Characteristics andimportance of organizational culture, Relevance of political,legal, economic and Cultural environments to globalbusiness, Structures and techniques organizations use asthey go international .

UNIT-II

Planning: Nature & Purpose, Steps involved in Planning, Objectives, Setting Objectives, Process of Managing by Objectives, Strategies, Policies & Planning Premises, CompetitorIntelligence, Benchmarking, Forecasting, Decision-Making.

Directing: Scope, Human Factors, Creativity and Innovation,Harmonizing Objectives, Leadership, Types of Leadership,Directing, Managers as leaders, Early LeadershipTheories…Trait Theories, Behavioral Theories, ManagerialGrid, Contingency Theories of Leadership, Directing ...PathGoal Theory, contemporary views of Leadership, CrossCultural Leadership, Leadership Training, Substitutes ofLeadership

UNIT-III

Organizing: Organizing ,Benefits and Limitations-De-Centralization andDelegation of Authority, Authority versus Power,Mechanistic Versus Organic Organization ,CommonOrganizational Designs, Contemporary OrganizationalDesigns and Contingency Factors, The LearningOrganization Nature and Purpose, Formal and InformalOrganization, Organization Chart, Structure and Process,Departmentalization by difference strategies, Line and Staffauthority- Benefits and Limitations-De-Centralization andDelegation of Authority Versus, Staffing,Human ResourceInventory, Job Analysis , Job Description, Recruitment and

UNIT - IV

Controlling: Controlling, Introduction to Controlling System and processof Controlling, Requirements for effective control, Theplanning Contol link, The process of control, types ofcontrol The Budget as Control Technique, InformationTechnology in Controlling, Productivity, Problems andManagement, Control of Overall Performance, Direct andPreventive Control, Financial Controls, Tools formeasuring organizational Performance, Contemporaryissues in control Workplace concerns, employee theft,employee violence

Textbook(s):

1. Tripathi PC. Principles of management. Tata McGraw-Hill Education; 6th Edition 2017.

References:

1. Koontz H, Weihrich H. Essentials of management: an international, innovation, and leadershipperspective. McGraw-Hill Education; 10th Edition 2018.
2. Principles of Management Text and Cases, Pravin Durai , Pearson ,2015
3. Robbins, S.P. &Decenzo, David A. Fundamentals of Management,7th ed., Pearson, 2010
4. Robbins, S.P. & Coulter, Mary Management; 14 ed.,Pearson , 2009

Programming in Python	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-2	CIE-332T
CSE-IoT/CSE-ICB	6	PC	PC	IOT-320T
EAE	6	IOT-EAE	IOT-EAE-2B	IOT-330T
EAE	6	ICB-EAE	ICB-EAE-2B	IOT-330T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Learn the syntax and semantics of Python Programming Language.
2.	Write Python functions to facilitate code reuse and manipulate strings.
3.	Illustrate the process of structuring the data using lists, tuples and dictionaries.
4.	Demonstrate the use of built-in functions to navigate the file system.

Course Outcomes (CO)

CO 1	Demonstrate the concepts of control structures in Python.
CO 2	Implement Python programs using functions and strings.
CO 3	Implement methods to create and manipulate lists, tuples and dictionaries
CO 4	Apply the concepts of file handling and regExusing packages.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	3	2	2	3
CO 2	3	2	2	2	3	-	-	-	3	2	2	3
CO 3	3	2	2	2	3	-	-	-	3	2	2	3
CO 4	3	2	2	2	3	-	-	-	3	2	2	3

UNIT-I

Introduction, Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Dissecting Your Program. Flow control: Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit().

UNIT-II

Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling. Lists: The List Data

Type, Working with Lists, Augmented Assignment Operators, Methods. Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things. Manipulating Strings - Working with Strings, Useful String Methods.

UNIT-III

Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint.pformat() Function. Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module.

UNIT – IV

Web Scraping: Project: MAPIT.PY with the web browser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML.

Textbooks:

1. Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015, ISBN: 978-1593275990.

References:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.
2. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.
3. Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.
4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithms in Python”, 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176.
5. Reema Thareja, “Python Programming using problem solving approach”, Oxford University press, 2017. ISBN-13: 978-0199480173

Programming in Python Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-2	CIE-332P
CSE-IoT/CSE-ICB	6	PC	PC	IOT-320P
EAE	6	IOT-EAE	IOT-EAE-2B	IOT-330P
EAE	6	ICB-EAE	ICB-EAE-2B	IOT-330P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Programming in Python) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Basic data types and operators: Create a program that prompts the user for their name and age and prints a personalized message.
2. Conditional statements: Create a program that prompts the user for their age and tells them if they can vote in the next election.
3. Loops: Create a program that calculates the factorial of a number entered by the user using a loop.
4. Lists and arrays: Create a program that prompts the user for a list of numbers and then sorts them in ascending order.
5. Strings and string manipulation: Create a program that prompts the user for a string and then prints out the string reversed.
6. Functions: Create a program that defines a function to calculate the area of a circle based on the radius entered by the user.
7. Classes and objects: Create a program that defines a class to represent a car and then creates an object of that class with specific attributes.
8. File input/output: Create a program that reads data from a file and writes it to another file in a different format.
9. Regular expressions: Create a program that uses regular expressions to find all instances of a specific pattern in a text file.
10. Exception handling: Create a program that prompts the user for two numbers and then divides them, handling any exceptions that may arise.
11. GUI programming: Create a program that uses a graphical user interface (GUI) to allow the user to perform simple calculations.
12. Web scraping: Create a program that uses a web scraping library to extract data from a website and then stores it in a database.
13. Data visualization: Create a program that reads data from a file and then creates a visualization of that data using a data visualization library.
14. Machine learning: Create a program that uses a machine learning library to classify images based on their content.
15. Networking: Create a program that uses a networking library to communicate with a server and retrieve data from it.

Statistics, Statistical Modelling & Data Analytics	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI/CSE-AIML/CSE-DS	6	PC	PC	DA-304T
EAE	6	AI-EAE	AI-EAE-2	DA-304T
EAE	6	AIML-EAE	AIML-EAE-2	DA-304T
EAE	6	DS-EAE	DS-EAE-1	DA-304T
EAE	6	SC-EAE	SC-EAE-1	DA-304T
EAE	6	MLDA-EAE	MLDA-EAE-1	DA-304T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To impart basic knowledge about Statistics, visualisation and probability.
2.	To impart basic knowledge about how to implement regression analysis and interpret the results.
3.	To impart basic knowledge about how to describe classes of open and closed sets of R, concept of compactness Describe Metric space - Metric in Rn.
4.	To impart basic knowledge about how to apply Eigen values, Eigen vectors.

Course Outcomes (CO)

CO 1	Ability to learn and understand the basic concepts about Statistics, visualisation and probability.
CO 2	Ability to implement regression analysis and interpret the results. Be able to fit a model to data and comment on the adequacy of the model
CO 3	Ability to describe classes of open and closed sets of R, concept of compactness Describe Metric space - Metric in Rn.
CO 4	Ability to impart basic knowledge about how to apply Eigen values, Eigen vectors.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	3	3	-	-	1	2	-	-	3
CO 2	3	3	3	3	3	-	-	1	2	-	-	3
CO 3	3	3	3	3	3	-	-	1	2	-	-	3
CO 4	3	3	3	3	3	-	-	1	2	-	-	3

UNIT-I

Statistics: Introduction & Descriptive Statistics- mean, median, mode, variance, and standard deviation. Data Visualization, Introduction to Probability Distributions.
Hypothesis testing, Linear Algebra and Population Statistics, Mathematical Methods and Probability Theory, Sampling Distributions and Statistical Inference, Quantitative analysis.

UNIT-II

Statistical Modelling: Linear models, regression analysis, analysis of variance, applications in various fields. Gauss-Markov theorem; geometry of least squares, subspace formulation of linear models, orthogonal projections; regression models, factorial experiments, analysis of covariance and model formulae; regression diagnostics, residuals, influence diagnostics, transformations, Box-Cox models, model selection and model building strategies, logistic regression models; Poisson regression models.

UNIT-III

Data Analytics: Describe classes of open and closed set. Apply the concept of compactness. Describe Metric space - Metric in Rn. Use the concept of Cauchy sequence, completeness, compactness and connectedness to solve the problems.

UNIT – IV

Advanced concepts in Data Analytics: Describe vector space, subspaces, independence of vectors, basis and dimension. Describe Eigen values, Eigen vectors and related results.

Textbook(s):

1. Apostol T. M. (1974): Mathematical Analysis, Narosa Publishing House, New Delhi.
2. Malik, S.C., Arora, S. (2012): Mathematical Analysis, New Age International, New Delhi

References:

1. Pringle, R.M. and Rayner, A.(1971): Generalized Inverse of Matrices with Application to Statistics, Griffin, London
2. Peter Bruce, Andrew Bruce (2017), Practical Statistics for Data Scientists Paperback

Statistics, Statistical Modelling & Data Analytics Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AI/CSE-AIML/CSE-DS	6	PC	PC	DA-304P
EAE	6	AI-EAE	AI-EAE-2	DA-304P
EAE	6	AIML-EAE	AIML-EAE-2	DA-304P
EAE	6	DS-EAE	DS-EAE-1	DA-304P
EAE	6	SC-EAE	SC-EAE-1	DA-304P
EAE	6	MLDA-EAE	MLDA-EAE-1	DA-304P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Statistics, Statistical Modelling & Data Analytics) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Exercises to implement the basic matrix operations in Scilab.
2. Exercises to find the Eigenvalues and eigenvectors in Scilab.
3. Exercises to solve equations by Gauss elimination, Gauss Jordan Method and Gauss Siedel in Scilab.
4. Exercises to implement the associative, commutative and distributive property in a matrix in Scilab.
5. Exercises to find the reduced row echelon form of a matrix in Scilab.
6. Exercises to plot the functions and to find its first and second derivatives in Scilab.
7. Exercises to present the data as a frequency table in SPSS.
8. Exercises to find the outliers in a dataset in SPSS.
9. Exercises to find the most risky project out of two mutually exclusive projects in SPSS
10. Exercises to draw a scatter diagram, residual plots, outliers leverage and influential data points in R
11. Exercises to calculate correlation using R
12. Exercises to implement Time series Analysis using R.
13. Exercises to implement linear regression using R.
14. Exercises to implement concepts of probability and distributions in R

Universal Human Values	L	P	C
	1		1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	6	HS/MS	HS	HS-304

Marking Scheme:

4. Teachers Continuous Evaluation: 25 marks

5. Term end Theory Examinations: 75 marks

6. This is an NUES paper, hence all examinations to be conducted by the concerned teacher.

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper.

Course Objectives :

1.	To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2.	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3.	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4.	To analyze the value of harmonious relationship based on trust and respect in their life and profession

Course Outcomes (CO)

CO 1	Evaluate the significance of value inputs in formal education and start applying them in their life and profession
CO 2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO 3	Examine the role of a human being in ensuring harmony in society and nature.
CO 4	Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	-	-	-	-	-	3	-	3	1	1	-	1
CO 2	-	-	-	-	-	3	-	3	1	1	-	1
CO 3	-	-	-	-	-	3	-	3	1	1	-	1
CO 4	-	-	-	-	-	3	-	3	1	1	-	1

UNIT-I

Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution: The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution

UNIT-II

Understanding Human Being: Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self

UNIT-III

Understanding Nature and Existence: A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self-awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).

UNIT - IV

Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living: Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence

Textbook(s):

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.
2. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists &Engineers, Oxford University Press
10. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web Technologies	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-356T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To explain web application development with HTML and CSS
2.	Learn about scripting languages Java Script and JSP Technologies
3.	To Learn Server-side Development with PHP
4.	Develop web applications using PHP and MYSQL

Course Outcomes (CO)

CO 1	Identify and illustrate the basic concepts of HTML and CSS & apply those concepts to design web pages
CO 2	Understand various concepts related to dynamic web pages and validate them using JavaScript and JSP
CO 3	Outline and understand the concepts of PHP for Web Development
CO 4	Integrate PHP, MYSQL and Scripting languages for web applications.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1		3	-	-	-	2	-	2	-	-	3	2
CO 2		-	2	-	-	-	2	-	-	3	-	-
CO 3	-	-	-	2	3	-	-	3	-	-	2	-
CO 4	3	-	3	-	-	3	3	-	3	-	-	3

UNIT-I

HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Html styles, Elements, Attributes, Heading, Layouts, I frames Images, Hypertext Links, Lists, Tables, Forms, Dynamic HTML.
CSS**:** Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors, and properties, manipulating texts, using fonts, borders, boxes, margins, padding lists, positioning using CSS, CSS2, The Box Model, Working with XML: Document Type Definition (DTD), XML schemas, Document object model, Parsers -DOM, and SAX. Introduction to XHTML: XML, Meta tags, Character entities, frames, and frame sets.

UNIT-II

JavaScript - Client-side scripting, Introduction to JavaScript, Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, JavaScript, and objects, JavaScript own objects, the DOM and web browser environments, forms and validations

Introduction to JSP**:** The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects, Using Beans in JSP Pages, Using Cookies and session for session tracking, connecting to database in JSP

UNIT-III

Introduction to Server-Side Development with PHP, what is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions.

UNIT – IV

PHP and MySQL: Basic commands with PHP examples, Connection to the server, creating a database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting the database, deleting data, and tables, PHP my admin and database bugs. Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State.

Textbooks:

1. Web Technologies: A Computer Science Perspective, Jackson, Pearson Education India, 2007.
2. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson, 2013.

References:

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech, 2009.
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning, 2003.
3. PHP and MySQL Web Development, Luke Welling, Addison Wesley

Web Technologies Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE/IT/CST/ITE	6	PCE	PCE-3	CIE-356P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Web Technologies) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Design web pages for your college containing a description of the courses, departments, faculties, library etc, use href, list tags.
2. Write html code to develop a webpage having two frames that divide the webpage into two equal rows and then divide the row into equal columns fill each frame with a different background color.
3. Design a web page of your home town with an attractive background color, text color, an Image, font etc. (use internal CSS).
4. Use External, Internal, and Inline CSS to format college web page that you created.
5. Create HTML Page with JavaScript which takes Integer number as input and tells whether the number is ODD or EVEN
6. Create HTML Page that contains form with fields Name, Email, Mobile No, Gender , Favourite Colour and a button now write a JavaScript code to combine and display the information in textbox when the button is clicked and implement validation.
7. Create XML file to store student information like Enrolment Number, Name Mobile Number , Email Id.
8. Write a php script to read data from txt file and display it in html table (the file contains info in format Name: Password: Email)
9. Write a PHP Script for login authentication. Design an html form which takes username and password from user and validate against stored username and password in file.
10. Write PHP Script for storing and retrieving user information from MySql table.

    a. Design A HTML page which takes Name, Address, Email and Mobile No. From user (register.php)

    b. Store this data in Mysql database / text file.

    c. Next page display all user in html table using PHP (display.php)

Blockchain Technology	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-ICB/CSE-CS	6	PC	PC	BT-308T
EAE	6	BT-EAE	BT-EAE-2	BT-308T
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-403T
EAE	7	ICB-EAE	ICB-EAE-5	BT-443T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the fundamental concepts along with cryptographic techniques of blockchain technology and analyze the architecture and components of a blockchain system.
2.	Explore various consensus algorithms and smart contracts employed in blockchain networks
3.	Evaluate the applications and use cases of blockchain technology.
4.	Discuss the challenges and potential future developments in blockchain.

Course Outcomes (CO)

CO 1	To be able to understand fundamental concepts, architecture, components and cryptographic techniques of blockchain technology
CO 2	To be able to understand various consensus algorithms and smart contracts
CO 3	To be able to understand the applications and use cases of blockchain technology.
CO 4	To be able to analyze challenges and potential future developments in blockchain technology.

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	3	-	-	-	2	2	2	3
CO 2	3	2	2	2	3	-	-	-	2	2	2	3
CO 3	3	2	2	2	3	-	-	-	2	2	2	3
CO 4	3	2	2	2	3	-	-	-	2	2	2	3

UNIT I

Introduction to Blockchain Technology: Evolution and history of blockchain, Characteristics and features of blockchain, Blockchain vs. traditional databases. Blockchain Architecture: Distributed ledger technology, Types of Blockchains, Components of a blockchain: blocks, transactions, nodes, Consensus mechanisms. Cryptographic Foundations: Hash functions and digital signatures, Public-key cryptography, Merkle trees and their applications, Zero-knowledge proofs

UNIT II

Consensus Algorithms: Proof of Work (PoW), Proof of Stake (PoS), Practical Byzantine Fault Tolerance (PBFT), Delegated Proof of Stake (DPoS). Smart Contracts: Introduction to smart contracts, Solidity programming language, Ethereum Virtual Machine (EVM), Deploying and executing smart contracts

UNIT III

Blockchain Applications: Cryptocurrencies and digital assets, Supply chain management, Identity management, Healthcare and medical records. Privacy and Security in Blockchain, Privacy-enhancing techniques (e.g., ring signatures, zero-knowledge proofs), Security vulnerabilities and attacks, Auditing and accountability in blockchain systems

UNIT IV

Blockchain Governance and Regulations: Decentralized autonomous organizations (DAOs), Legal and regulatory considerations, Government initiatives and policies. Future Trends and Challenges: Scalability and performance issues, Integration with emerging technologies (e.g., AI, IoT), Sustainability and energy consumption, Industry adoption and standards

Text Books:

1. "Mastering Blockchain" by Imran Bashir
2. “Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher

Reference Books:

1. "Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations" by Henning Diedrich.

Blockchain Technology Lab	**L**	**P**	**C**
		2	**1**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-ICB/CSE-CS	6	PC	PC	BT-308P
EAE	6	BT-EAE	BT-EAE-2	BT-308P
CSE/IT/CST/ITE	7	PCE	PCE-4	CIE-403P
EAE	7	ICB-EAE	ICB-EAE-5	BT-443P

Marking Scheme:

1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:

1. The course objectives and course outcomes are identical to that of (Blockchain Technology) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Create a Simple Blockchain in any suitable programming language.
2. Use Geth to Implement Private Ethereum Block Chain.
3. Build Hyperledger Fabric Client Application.
4. Create and deploy a block chain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chaincode, and perform invoke and query on your block chain network.
5. Interact with a block chain network. Execute transactions and requests against a block chain network by creating an app to test the network and its rules (https://developer.ibm.com/patterns/interacting-with-a-block chain-network/)
6. Deploy an asset-transfer app using block chain. Learn app development within a Hyperledger Fabric network (https://developer.ibm.com/patterns/deploy-an-asset-transfer-app-using-block chain/)
7. Use block chain to track fitness club rewards Build a web app that uses Hyperledger Fabric to track and trace member rewards
8. Interat with a blockchain network. Execute transactions and requestes against a blockchain network by creatingan app to test the network and its rules.

Emerging Area Elective Groups (for Minor Specialization) – Applicable only for Core Disciplines (EAE)

The minor specialization is offered through a set of five papers that the student has to study to acquire the minor specialization. The number of papers to be studied is two in 6th semester and three in 7th semester. The minor specialization shall be awarded if and only if 20 credits are earned from an individual / specific minor specialization area. From each paper group associated with a paper slot in a particular semester, the student shall be allowed to study only one paper group. The papers shall be allowed to be taken / studied by the students, by the APC of the department / institute, keeping in view that two papers studied by the student should not have a substantial overlap. All papers studied by the student should be substantially distinct in content.

Minor specialization is not necessary for award of the degree, the student may choose five papers from the groups offered by the institution to a particular student (belonging to a major discipline) across groups. Minimum two minor specialization groups should be offered by the institution to students of any particular major discipline from either of the open area or emerging area groups

An elective shall be offered to the student for each Minor Specialization group in Emerging Area (That is for EAE-1, EAE-2, etc.) based on the availability of resources and faculty at the institution and at least one third of the batch or at least 20 students must be willing to take the elective.

Each EAE slot is of 4 credits, if in a particular slot, the paper has no practical component, then it is of 4 credits (a pure theory paper), otherwise for purpose of examination and conduct of classes, the course is split in two papers, namely a theory paper of 3 credits and a practical paper of 1 credit. The student has to study for 4 credits per slot of EAE group. This is reflected by suffixing the paper code by T (for Theory component) and P (for Practical component), if required. The nomenclature of the paper group is <*ACRONYM OF EMERGING AREA*> - EAE - <SLOT NUMBER>< A or B or C etc., if required>. The major disciplines to which the Emerging Area Elective Group papers can be offered is specified as acronym together with the name of the minor specialization.

In lieu of Emerging Area Elective, students can study papers from Open Area Elective groups also as offered to them.

Emerging Area Specialization: Artificial Intelligence (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	AI-EAE-1	AI-302T	Artificial Intelligence	3		3
		AI-302P	Artificial Intelligence Lab		2	1
6	AI-EAE-2	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
7	AI-EAE-3	SC-401T	Soft Computing	3		3
		SC-401P	Soft Computing Lab		2	1
7	AI-EAE-4	AI-403T	Artificial Intelligence Applications	3		3
		AI-403P	Artificial Intelligence Applications Lab		2	1
7	AI-EAE-5	AI-405T	Intelligent and Expert Systems	3		3
		AI-405P	Intelligent and Expert Systems Lab		2	1

Emerging Area Specialization: Artificial Intelligence and Machine Learning (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	AIML-EAE-1	AI-302T	Artificial Intelligence	3		3
		AI-302P	Artificial Intelligence Lab		2	1
6	AIML-EAE-2	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
7	AIML-EAE-3	ML-407T	Machine Learning	3		3
		ML-407P	Machine Learning Lab		2	1
7	AIML-EAE-4	ML-409T	Reinforcement Learning and Deep Learning	3		3
		ML-409P	Reinforcement Learning and Deep Learning Lab		2	1
7	AIML-EAE-5	ML-411T	Pattern Recognition and Computer Vision	3		3
		ML-411P	Pattern Recognition and Computer Vision Lab		2	1

Emerging Area Specialization: Data Science (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	DS-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	DS-EAE-2	AI-316T	Artificial Intelligence and Machine Learning	3		3
		AI-316P	Artificial Intelligence and Machine Learning Lab		2	1
7	DS-EAE-3	DS-427T	Data Science using R	3		3
		DS-427P	Data Science using R Lab		2	1
7	DS-EAE-4	DS-429T	Big Data Analytics	3		3
		DS-429P	Big Data Analytics Lab		2	1
7	DS-EAE-5A OR	DS-431T	Business Intelligence	3		3
		DS-431P	Business Intelligence Lab		2	1
	DS-EAE-5B	DS-433T	Exploratory Data Analytics and Data Visualization	3		3
		DS-433P	Exploratory Data Analytics and Data Visualization Lab		2	1

Emerging Area Specialization: Block Chain Technology (for CSE / IT / CST / ITE/ECE/EE/EEE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	BT-EAE-1	CS-306T	Mathematics of Modern Cryptography	3		3
		CS-306P	Mathematics of Modern Cryptography Lab		2	1
6	BT-EAE-2	BT-308T	Blockchain Technology	3		3
		BT-308P	Blockchain Technology Lab		2	1
7	BT-EAE-3	BT-413T	Bitcoin and Cryptocurrency Technologies	3		3
		BT-413P	Bitcoin and Cryptocurrency Technologies Lab		2	1
7	BT-EAE-4	BT-415T	Smart Contracts	3		3
		BT-415P	Smart Contracts Lab		2	1
7	BT-EAE-5A OR	BT-417T	Blockchain for Cyber Security	3		3
		BT-417P	Blockchain for Cyber Security Lab		2	1
	BT-EAE-5B	BT-419T	Blockchain Technology in Web Development	3		3
		BT-419P	Blockchain Technology in Web Development Lab		2	1

Emerging Area Specialization: Internet of Things (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	IOT-EAE-1A OR	IOT-324T	Introduction to Internet of Things	3		3
		IOT-324P	Introduction to Internet of Things Lab		2	1
	IOT-EAE-1B	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
6	IOT-EAE-2A OR	ES-328T	Embedded Linux	3		3
		ES-328P	Embedded Linux Lab		2	1
	IOT-EAE-2B OR	IOT-330T	Programming in Python	3		3
		IOT-330P	Programming in Python Lab		2	1
	IOT-EAE-2C	IOT-332T	Wireless Sensor Networks	3		3
		IOT-332P	Wireless Sensor Networks Lab		2	1
7	IOT-EAE-3	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
		IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
7	IOT-EAE-4	IOT-443T	Design of Smart Systems	3		3
		IOT-443P	Design of Smart Systems Lab		2	1
7	IOT-EAE-5A OR	IOT-445T	Internet of Things Industrial and Medical Case Studies	3		3
		IOT-445P	Internet of Things Industrial and Medical Case Studies Lab		2	1
	IOT-EAE-5B OR	IOT-447T	Internet of Things Frameworks	3		3
		IOT-447P	Internet of Things Frameworks Lab		2	1
	IOT-EAE-5C	IOT-449	Privacy and Security issues in IoT	4		4

Emerging Area Specialization: Internet of Things and Cyber Security including Block Chain Technology (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ICB-EAE-1A OR	IOT-324T	Introduction to Internet of Things	3		3
		IOT-324P	Introduction to Internet of Things Lab		2	1
	ICB-EAE-1B	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
6	ICB-EAE-2A OR	ES-328T	Embedded Linux	3		3
		ES-328P	Embedded Linux Lab		2	1
	ICB-EAE-2B OR	IOT-330T	Programming in Python	3		3
		IOT-330P	Programming in Python Lab		2	1
	ICB-EAE-2C	IOT-332T	Wireless Sensor Networks	3		3
		IOT-332P	Wireless Sensor Networks Lab		2	1
7	ICB-EAE-3	CS-423T	Cyber Security and Forensics	3		3
		CS-423P	Cyber Security and Forensics Lab		2	1
7	ICB-EAE-4	IOT-441T	IoT with Arduino, ESP and Raspberry Pi	3		3
		IOT-441P	IoT with Arduino, ESP and Raspberry Pi Lab		2	1
7	ICB-EAE-5	BT-443T	Blockchain Technology	3		3
		BT-443P	Blockchain Technology Lab		2	1

Emerging Area Specialization: Networks (for CSE / IT / CST / ITE / ECE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	NET-EAE-1	NET-344T	Advanced Computer Networks and Administration	3		3
		NET-344P	Advanced Computer Networks and Administration Lab		2	1
6	NET-EAE-2	NET-346T	Linux System Administration	3		3
		NET-346P	Linux System Administration Lab		2	1
7	NET-EAE-3	NET-471T	Network Programming	3		3
		NET-471P	Network Programming Lab		2	1
7	NET-EAE-4	NET-473T	Cloud Computing and Security	3		3
		NET-473P	Cloud Computing and Security Lab		2	1
7	NET-EAE-5	NET-475T	Wireless Sensor Networks	3		3
		NET-475P	Wireless Sensor Networks Lab		2	1

Emerging Area Specialization: Cyber Security (for CSE / IT / CST / ITE / ECE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	CS-EAE-1	CS-310T	Information Theory and Coding	3		3
		CS-310P	Information Theory and Coding Lab		2	1
6	CS-EAE-2A OR	CS-312T	Network Security and Cryptography	3		3
		CS-312P	Network Security and Cryptography Lab		2	1
	CS-EAE-2B	CS-314T	Network Security Issues and Challenges	3		3
		CS-314P	Network Security Issues and Challenges Lab		2	1
7	CS-EAE-3	CS-421T	Cyber Crime and Cyber Laws	3		3
		CS-421P	Cyber Crime and Cyber Laws Lab		2	1
7	CS-EAE-4	CS-423T	Cyber Security and Forensics	3		3
		CS-423P	Cyber Security and Forensics Lab		2	1
7	CS-EAE-5	CS-425T	Ethical Hacking	3		3
		CS-425P	Ethical Hacking Lab		2	1

Emerging Area Specialization: Soft Computing (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	SC-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	SC-EAE-2	ML-348T	Artificial Neural Networks and Deep Learning	3		3
		ML-348P	Artificial Neural Networks and Deep Learning Lab		2	1
7	SC-EAE-3	SC-477T	Fuzzy Systems and Applications	3		3
		SC-477P	Fuzzy Systems and Applications Lab		2	1
7	SC-EAE-4	SC-479T	Global Optimization Methods	3		3
		SC-479P	Global Optimization Methods Lab		2	1
7	SC-EAE-5	SC-481T	Soft Computing and Expert Systems	3		3
		SC-481P	Soft Computing and Expert Systems Lab		2	1

Emerging Area Specialization: Machine Learning & Data Analytics (for CSE / IT / CST / ITE / ECE / EE / EEE / ICE / ME / CE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	MLDA-EAE-1	DA-304T	Statistics, Statistical Modelling & Data Analytics	3		3
		DA-304P	Statistics, Statistical Modelling & Data Analytics Lab		2	1
6	MLDA-EAE-2A OR	DA-338T	Data Analytics	3		3
		DA-338P	Data Analytics Lab		2	1
	MLDA-EAE-2B OR	DS-340T	Data Visualization	3		3
		DS-340P	Data Visualization Lab		2	1
	MLDA-EAE-2C	ML-342T	Machine Learning	3		3
		ML-342P	Machine Learning Lab		2	1
7	MLDA-EAE-3	ML-463T	Supervised and Deep Learning	3		3
		ML-463P	Supervised and Deep Learning Lab		2	1
7	MLDA-EAE-4	ML-465T	Unsupervised Learning	3		3
		ML-465P	Unsupervised Learning Lab		2	1
7	MLDA-EAE-5A OR	ML-467T	Machine Learning and Data Analytics Case Studies	3		3
		ML-467P	Machine Learning and Data Analytics Case Studies Lab		2	1
	MLDA-EAE-5B	ML-469T	Machine Learning and Data Analytics Frameworks	3		3
		ML-469P	Machine Learning and Data Analytics Frameworks Lab		2	1

Emerging Area Specialization: Software Engineering (for CSE / IT / CST / ITE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	SE-EAE-1	SE-350T	Software Measurements, Metrics and Modelling	3		3
		SE-350P	Software Measurements, Metrics and Modelling Lab		2	1
6	SE-EAE-2A OR	SE-352T	Service Oriented Architecture	3		3
		SE-352P	Service Oriented Architecture Lab		2	1
	SE-EAE-2B	SE-354T	Software Project Management	3		3
		SE-354P	Software Project Management Lab		2	1
7	SE-EAE-3	SE-483T	Mining Software Repositories and Predictive Modelling	3		3
		SE-483P	Mining Software Repositories and Predictive Modelling Lab		2	1
7	SE-EAE-4A OR	SE-485	Software Security	4		4
	SE-EAE-4B	SE-487T	Software Verification, Validation and Testing	3		3
		SE-487P	Software Verification, Validation and Testing Lab		2	1
7	SE-EAE-5	SE-489	Software Engineering Standards	4		4

Emerging Area Specialization: Full Stack Development (for CSE / IT / CST / ITE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	FSD-EAE-1	FSD-318T	Advanced Java Programming	3		3
		FSD-318P	Advanced Java Programming Lab		2	1
6	FSD-EAE-2A OR	FSD-320T	Web Development using MEAN Stack	3		3
		FSD-320P	Web Development using MEAN Stack Lab		2	1
	FSD-EAE-2B	FSD-322T	Web Development using MERN Stack	3		3
		FSD-322P	Web Development using MERN Stack Lab		2	1
7	FSD-EAE-3	FSD-435T	PHP Programming and MySQL	3		3
		FSD-435P	PHP Programming and MySQL Lab		2	1
7	FSD-EAE-4	FSD-437T	Mobile App Development	3		3
		FSD-437P	Mobile App Development Lab		2	1
7	FSD-EAE-5	FSD-439T	Web and Mobile Application Testing and Deployment	3		3
		FSD-43P	Web and Mobile Application Testing and Deployment Lab		2	1

Emerging Area Specialization: Image Processing and Computer Vision (for CSE/IT/CST/ITE/ECE/ EE / EEE / ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	IPCV-EAE-1A OR	IPCV-334T	Digital Image Processing	3		3
		IPCV-334P	Digital Image Processing Lab		2	1
	IPCV-EAE-1B	IPCV-356T	Digital Signal and Image Processing	3		3
		IPCV-356P	Digital Signal and Image Processing Lab		2	1
6	IPCV-EAE-2	IPCV-336T	Pattern Recognition	3		3
		IPCV-336P	Pattern Recognition Lab		2	1
7	IPCV-EAE-3	IPCV-451T	Computer Vision	3		3
		IPCV-451P	Computer Vision Lab		2	1
7	IPCV-EAE-4A OR	IPCV-453T	Biometrics	3		3
		IPCV-453P	Biometrics Lab		2	1
	IPCV-EAE-4B OR	IPCV-455T	Medical Image Processing, Analysis and Reconstruction	3		3
		IPCV-455P	Medical Image Processing, Analysis and Reconstruction Lab		2	1
	IPCV-EAE-4C	IPCV-457T	Remote Sensing Image Analysis and Classification	3		3
		IPCV-457P	Remote Sensing Image Analysis and Classification Lab		2	1
7	IPCV-EAE-5A OR	IPCV-459T	Deep Learning for Image Processing and Computer Vision	3		3
		IPCV-459P	Deep Learning for Image Processing and Computer Vision Lab		2	1
	IPCV-EAE-5B	IPCV-461T	Machine Learning for Image and Vision Analysis	3		3
		IPCV-461P	Machine Learning for Image and Vision Analysis Lab		2	1

Emerging Area Specialization: Robotics and Automation (for ECE / ICE / ME)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	RA-EAE-1	RA-324T	Robot Kinematics and Dynamics	3		3
		RA-324P	Robot Kinematics and Dynamics Lab		2	1
6	RA-EAE-2	IOT-326T	Introduction to Sensors and Transducers	3		3
		IOT-326P	Introduction to Sensors and Transducers Lab		2	1
7	RA-EAE-3	RA-437T	Robot Actuation Systems	3		3
		RA-437P	Robot Actuation Systems Lab		2	1
7	RA-EAE-4	RA-439T	Control Hardware and Interfacing	3		3
		RA-439P	Control Hardware and Interfacing Lab		2	1
7	RA-EAE-5	RA-441T	AI in Robotics	3		3
		RA-441P	AI in Robotics Lab		2	1

Emerging Area Specialization: Embedded Systems (for CSE/IT/CST/ITE/ECE/EE/EEE /ICE)

Semester	Paper Group	Paper Code	Paper Name	L	P	Credits
6	ES-EAE-1A OR	ES-302T	Microprocessors and Interfacing	3		3
		ES-302P	Microprocessors and Interfacing Lab		2	1
	ES-EAE-1B OR	ES-308T	Introduction to Data Communication and Networking	3		3
		ES-308P	Introduction to Data Communication and Networking Lab		2	1
	ES-EAE-1C	ES-310T	Advanced Microprocessors (ARM) & Interfacing	3		3
		ES-310P	Advanced Microprocessors (ARM) & Interfacing Lab		2	1
6	ES-EAE-2A OR	ES-304	Real Time Operating Systems	4		4
	ES-EAE-2B	ES-306T	Embedded System Architecture and Design	3		3
		ES-306P	Embedded System Architecture and Design Lab		2	1
7	ES-EAE-3A OR	ES-401T	Programming in C for Embedded Systems	3		3
		ES-401P	Programming in C for Embedded Systems Lab		2	1
	ES-EAE-3B	ES-403T	VHDL Programming	3		3
		ES-403P	VHDL Programming Lab		2	1
7	ES-EAE-4	ES-405T	Real Time Embedded System Programming	3		3
		ES-405P	Real Time Embedded System Programming Lab		2	1
7	ES-EAE-5A OR	ES-407T	Embedded Linux	3		3
		ES-407P	Embedded Linux Lab		2	1
	ES-EAE-5B OR	IOT-409T	Introduction to Sensors and Transducers	3		3
		IOT-409P	Introduction to Sensors and Transducers Lab		2	1
	ES-EAE-5C	ES-411T	Logic Design and Analysis using Verilog	3		3
		ES-411P	Logic Design and Analysis using Verilog Lab		2	1

Machine Learning	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-350T
EAE	6	MLDA-EAE	MLDA-EAE-2C	ML-342T
CSE/IT/CST/ITE	7	PCE	PCE-5	CIE-421T
CSE-AIML	7	PC	PC	ML-407T
EAE	7	AIML-EAE	AIML-EAE-3	ML-407T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand the need of machine learning
2.	To learn about regression and feature selection
3.	To understand about classification algorithms
4.	To learn clustering algorithms

Course Outcomes (CO)

CO 1	To formulate machine learning problems
CO 2	Learn about regression and feature selection techniques
CO 3	Apply machine learning techniques such as classification to practical applications
CO 4	Apply clustering algorithms

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	3	3	3	3	2	2	-	-	-	-	2
CO 2	3	3	3	3	3	2	2	-	-	-	-	2
CO 3	3	3	3	3	3	2	2	-	-	-	-	2
CO 4	3	3	3	3	3	2	2	-	-	-	-	2

UNIT-I

Introduction: Machine learning, terminologies in machine learning, Perspectives and issues in machine learning, application of Machine learning, Types of machine learning: supervised, unsupervised, semi-supervised learning. Review of probability, Basic Linear Algebra in Machine Learning Techniques, Dataset and its types,Data preprocessing, Bias and Variance in Machine learning , Function approximation, Overfitting

UNIT-II

Regression Analysis in Machine Learning: Introduction to regression and its terminologies,Types of regression,Logistic Regression

Simple Linear regression: Introduction to Simple Linear Regression and its assumption, Simple Linear Regression Model Building,Ordinary Least square estimation, Properties of the least-squares estimators and the fitted regression model, Interval estimation in simple linear regression , Residuals
Multiple Linear Regression:Multiple linear regression model and its assumption, **Interpret Multiple Linear Regression Output(R-Square, Standard error, F, Significance F, Cofficient P values), Access the fit of multiple linear regression model (**R squared, Standard error)
Feature Selection and Dimensionality Reduction: PCA, LDA, ICA

UNIT-III

Introduction to Classification and Classification Algorithms: What is Classification? General Approach to Classification, k-Nearest Neighbor Algorithm, Random Forests, Fuzzy Set Approaches
Support Vector Machine: Introduction, Types of support vector kernel – (Linear kernel, polynomial kernel, and Gaussiankernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM.
Decision Trees: Decision tree learning algorithm,ID-3algorithm, Inductive bias, Entropy and information theory, Information gain,Issues in Decision tree learning.
Bayesian Learning - Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm
Ensemble Methods: Bagging, Boosting and AdaBoost and XBoost,
Classification Model Evaluation and Selection: Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value, Lift Curves and Gain Curves, ROC Curves, Misclassification Cost Adjustment to Reflect Real-World Concerns, Decision Cost/Benefit Analysis

UNIT – IV

Introduction to Cluster Analysis and Clustering Methods: The Clustering Task and the Requirements for Cluster Analysis , Overview of Some Basic Clustering Methods:-k-Means Clustering, k-Medoids Clustering, Density-Based Clustering: DBSCAN - Density-Based Clustering Based on Connected Regions with High Density, Gaussian Mixture Model algorithm , Balance Iterative Reducing and Clustering using Hierarchies (BIRCH) , Affinity Propagation clustering algorithm,Mean-Shift clustering algorithm, ordering Points to Identify the Clustering Structure (OPTICS) algorithm, Agglomerative Hierarchy clustering algorithm, **Divisive Hierarchical** , Measuring Clustering Goodness

Textbook(s):

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013.
2. M. Gopal, “Applied Machine Learning”, McGraw Hill Education

References:
1. C. M. BISHOP (2006), “Pattern Recognition and Machine Learning”, Springer-Verlag New York, 1st Edition
2. R. O. Duda, P. E. Hart, D. G. Stork (2000), Pattern Classification, Wiley-Blackwell, 2nd Edition

Machine Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
ECE	6	PCE	PCE-3	ECE-350P
EAE	6	MLDA-EAE	MLDA-EAE-2C	ML-342P
CSE/IT/CST/ITE	7	PCE	PCE-5	CIE-421P
CSE-AIML	7	PC	PC	ML-407P
EAE	7	AIML-EAE	AIML-EAE-3	ML-407P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Machine Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Introduction to JUPYTER IDE and its libraries Pandas and NumPy
2. Program to demonstrate Simple Linear Regression
3. Program to demonstrate Logistic Regression
4. Program to demonstrate Decision Tree – ID3 Algorithm
5. Program to demonstrate k-Nearest Neighbor flowers classification
6. Program to demonstrate Naïve- Bayes Classifier
7. Program to demonstrate PCA and LDA on Iris dataset
8. Program to demonstrate DBSCAN clustering algorithm
9. Program to demonstrate K-Medoid clustering algorithm
10. Program to demonstrate K-Means Clustering Algorithm on Handwritten Dataset

Pattern Recognition and Computer Vision	**L**	**P**	**C**
	3		**3**

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	7	PC	PC	ML-411T
EAE	7	AIML-EAE	AIML-EAE-5	ML-411T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	Understand the in-depth concept of Pattern Recognition
2.	Implement Bayes Decision Theory
3.	Understand the in-depth concept of Perception and related Concepts
4.	Understand the concept of ML Pattern Classification

Course Outcomes (CO)

CO 1	Discuss various concepts of pattern recognition
CO 2	Understanding various algorithms
CO 3	Explain and apply various computer vision techniques
CO 4	Describe the concept of shape analysis and filtering

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO 1	3	2	2	3	3	-	2	-	-	1	3	2
CO 2	3	3	1	1	1	-	1	1	-	2	2	1
CO 3	3	2	3	3	2	-	2	-	-	2	3	1
CO 4	1	2	3	2	2	-	1	-	-	1	2	2

UNIT-I

Induction Algorithms. Rule Induction. Decision Trees. Bayesian Methods. The Basic Naıve Bayes Classifier. Naive Bayes Induction for Numeric Attributes. Correction to the Probability Estimation. Laplace Correction. No Match. Other Bayesian Methods. Other Induction Methods. Neural Networks. Genetic Algorithms. Instance-based Learning. Support Vector Machines.

UNIT-II

About Statistical Pattern Recognition. Classification and regression. Features and Feature Vectors, and Classifiers. Pre-processing and feature extraction. The curse of dimensionality. Polynomial curve fitting. Model complexity. Multivariate non-linear functions. Bayes' theorem. Decision boundaries. Parametric methods. Sequential parameter estimation. Linear discriminant functions. Fisher's linear discriminant. Feed-forward network mappings.

UNIT-III

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

UNIT – IV

Binary shape analysis – connectedness – object labelling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

Textbook(s):

1. Pattern Classification, Richard O. Duda, Peter E. Hart, and David G. Stork. Wiley, 2000, 2nd Edition
2. D. L. Baggio et al., Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing, 2012.

References:

1. Pattern Recognition, Jürgen Beyerer, Matthias Richter, and Matthias Nagel. 2018
2. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012

Pattern Recognition and Computer Vision Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	7	PC	PC	ML-411P
EAE	7	AIML-EAE	AIML-EAE-5	ML-411P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Pattern Recognition and Computer Vision) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Write a MATLAB/Python function that computes the value of the Gaussian distribution N(m,s) at given vector X and plot the effect of varying mean and variance to the normal distribution.
2. Implementation of Gradient descent.
3. Implementation of Linear Regression using Gradient descent.
4. Comparison of classification accuracy of SVM and CNN for the dataset.
5. Implementation basic Image Handling and processing operations on the image.
6. Implementation of Geometric Transformation.
7. Implementation of Perspective Transformation.
8. Implementation of Camera Calibration
9. Compute Fundamental Matrix.

Principles of Entrepreneurship Mindset	L	P	C
	2		2

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
All	7	HS/MS	MS	MS-401

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand basic aspects of establishing a business in a competitive environment
2.	To apply the basic understanding to examine the existing business ventures
3.	To examine various business considerations such as marketing, financial and teaming etc.
4.	To assess strategies for planning a business venture

Course Outcomes (CO)

CO 1	Understand basic aspects of establishing a business in a competitive environment
CO 2	Apply the basic understanding to examine the existing business ventures
CO 3	Examine various business considerations such as marketing, financial and teaming etc.
CO 4	Assessing strategies for planning a business venture

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	2	2	1	2	-	2	-	-	1	2	3	2
CO 2	2	2	1	2	-	2	-	-	1	2	3	2
CO 3	2	2	1	2	-	2	-	-	1	2	3	2
CO 4	2	2	1	2	-	2	-	-	1	2	3	2

UNIT-I

Entrepreneurial perspective: Foundation, Nature and development ofentrepreneurship, importance of entrepreneurs,Entrepreneurial Mind, Individual entrepreneur Typesof entrepreneurs, Entrepreneurship in India

UNIT-II

Beginning Considerations: Creativity and developing business ideas; Creatingand starting the venture; Building a competitiveadvantage; Opportunity recognition, Opportunityassessment; Legal issues

UNIT-III

Developing Financial Plans: Sources of Funds,Managing Cash Flow,Creating a successful Financial PlanDeveloping a business plan

UNIT - IV

Developing Marketing Plans: Developing a powerful Marketing Plan, E-commerce,Integrated Marketing Communications
Leading Considerations: Developing Team, Inviting candidates to join team,Leadership model

Textbook(s):

1. Robert D Hisrich, Michael P Peters & Dean A Shepherd, "Entrepreneurship" 10th Edition,McGraw Hill Education, 2018

References:

1. Norman M. Scarborough and Jeffery R. cornwell, "Essentials of entrepreneurship and small business management" 8th Edition, Pearson, 2016
2. Rajiv Roy, "Entrepreneurship", 2nd Edition, Oxford University Press, 2011
3. Sangeeta Sharma, "Entrepreneurship Development", 1st Edition, Prentice-Hall India, 2016
4. John Mullins, "The New Business Road Test: What entrepreneurs and investors should dobefore launching a lean start-up" 5th Edition, Pearson Education, 2017
5. Charantimath, Entrepreneurship Development and Small Business Enterprise, Pearson Education.

Reinforcement Learning and Deep Learning	L	P	C
	3		3

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	7	PC	PC	ML-409T
EAE	7	AIML-EAE	AIML-EAE-4	ML-409T

Marking Scheme:

1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:

1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To introduce the foundation of Reinforcement learning foundation and Q Network algorithm)
2.	To understand policy optimization ,recent advanced techniques and applications of Reinforcement learning
3.	To introduce the concept of deep learning and neural network
4.	To understand the concept of NLP and computer vision in deep learning

Course Outcomes (CO)

CO 1	Learn how to define RL tasks and the core principals behind the RL, including policies, value functions, deriving Bellman equations and underst and work with approximate solution(deep Q Network based algorithms)
CO 2	Learn the policy gradient methods from vanilla to more complex cases and learn application and advanced techniques in Reinforcement Learning
CO 3	Apply neural networks for problem solving
CO 4	Able to Analyse images and have basic understanding of NLP in deep learning

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	3	3	3	2	2	-	-	-	-	2
CO 2	3	2	3	3	3	2	2	-	-	-	-	2
CO 3	3	2	3	3	3	2	2	-	-	-	-	2
CO 4	3	2	3	3	3	2	2	-	-	-	-	2

UNIT-I

Reinforcement Learning Foundation: Introduction to Reinforcement learning and its terms,Features and elements of RL, Defining RL Framework and Markov Decision Process , Polices, Value Functions and Bellman Equations, Exploration vs. Exploitation, Code Standards and Libraries used in RL (Python/Keras/Tensorflow)
Tabular Methods and Q-networks: Planning through the use of Dynamic Programming and Monte Carlo, Temporal-Difference learning methods (TD(0), SARSA, Q-Learning), Deep Q-networks (DQN, DDQN, Dueling DQN, Prioritised Experience Replay)

UNIT-II

Policy Optimization: Introduction to policy-based methods, Vanilla Policy Gradient, REINFORCE algorithm and stochastic policy search, Actor-critic methods (A2C, A3C) ,Advanced policy gradient (PPO, TRPO, DDPG),
Model-Based RL: Model-based RL approach
Recent Advances and Applications: Meta-learning. Multi-Agent Reinforcement Learning, Partially Observable Markov Decision Process, Applying RL for real-world problems

UNIT-III

Introduction to Deep learning: Introduction to deep learning and its application,Examples of deep learning
Introduction to Neural Network: Introduction to Neural Network its types and application,Introduction to keras,Introduction to ANN Perceptron and its uses,Multilayer perceptron and deep neural network,Activation function and its working TanH function,sigma ,relu etc ,Feed forward network, Cost function, Backpropagation, Gradient Descent, Regulariztion and dropout technique, Batch normalization.
Types of Neural Network: Convolutional Neural network,CNN Pooling,CNN Layers,Flattening and Full connection,Preparing a fully connected neural network,Introduction to RNN, Deep RNN, Long Short Term Memory, GRU, Transfer Learning,

UNIT – IV

Deep Learning for Natural Language Processing: Introduction to NLP and Vector Space Model of Semantics Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW), Glove, Evaluations and Applications in word similarity, analogy reasoning
Deep Learning for Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models. Attention models for computer vision tasks.

Textbook(s):
1.Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", 2nd Edition, MIT Press, 2019
2. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. "Deep learning." MIT press, 2016.
3. Antonio Gulli and Sujit Pal,"Deep learning with Keras"

References:
1. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning: Adaptation, Learning, and Optimization" (2012)
2. Daniel Slater, Gianmario Spacagna and Peter Roelants, "Python Deep Learning", Packt Publication.

Reinforcement Learning and Deep Learning Lab	L	P	C
		2	1

Discipline(s) / EAE / OAE	Semester	Group	Sub-group	Paper Code
CSE-AIML	7	PC	PC	ML-409P
EAE	7	AIML-EAE	AIML-EAE-4	ML-409P

Marking Scheme:
1. Teachers Continuous Evaluation: 40 marks
2. Term end Theory Examinations: 60 marks

Instructions:
1. The course objectives and course outcomes are identical to that of (Reinforcement Learning and Deep Learning) as this is the practical component of the corresponding theory paper.
2. The practical list shall be notified by the teacher in the first week of the class commencement under intimation to the office of the Head of Department / Institution in which the paper is being offered from the list of practicals below. Atleast 10 experiments must be performed by the students, they may be asked to do more. Atleast 5 experiments must be from the given list.

1. Setting up the Spyder IDE Environment and Executing a Python Program
2. Installing Keras, Tensorflow and Pytorch libraries and making use of them
3. Implement Q-learning with pure Python to play a game
   - Environment set up and intro to OpenAI Gym
   - Write Q-learning algorithm and train agent to play game
   - Watch trained agent play game
4. Implement deep Q-network with PyTorch
5. Python implementation of the iterative policy evaluation and update.
6. Chatbot using bi-directional LSTMs
7. Image classification on MNIST dataset (CNN model with fully connected layer)
8. Train a sentiment analysis model on IMDB dataset, use RNN layers with LSTM/GRU
9. Applying the Deep Learning Models in the field of Natural Language Processing
10. Applying the Convolution Neural Network on computer vision problems