

Graphic Era Hill University, Dehradun

SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS-308** Course Title: **Logic Design & Computer Organization**
2. Contact Hours: L: **3** T: **0** P: **0**
3. Examination Duration (Hrs): Theory **3** Practical **0**
4. Relative Weight: CIE **25** MSE **25** SEE **50**
5. Credits: **3**
6. Semester: **3**
7. Category of Course: **DC**
8. Pre-requisite: Basic Electronics Engineering (TEC 101/201)

9. Course Outcome:	<p>After completion of the course the students will be able to:</p> <p>CO1: Understand the process of minimizing Boolean function and obtaining the combinational logic circuits from Boolean functions.</p> <p>CO2: Analyze the basic storage elements in digital circuits and develop sequential circuits by applying them.</p> <p>CO3: Evaluate the design of different types of register, counter, and programmable logic devices.</p> <p>CO4: Apply the concept of digital logic circuits in computer organization & architecture and evaluate the computer performance.</p> <p>CO5: Create the arithmetic logic used in computer and describe the machine instruction execution.</p> <p>CO6: Understand the memory hierarchy of computer and how different I/O devices interact with the processing unit.</p>
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**** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.**

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	<p>Unit 1: Simplification of Boolean Function using K-map method (upto 5 variables) and Quine-Mc Clusky method. Nand and Nor Implementation. Combinational Logic: Introduction, Analysis & Design Procedure, Binary Adder & Subtractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers, Demultiplexers, code conversion. Introduction to HDL description of combinational logic circuits.</p>	10
2	<p>Unit 2: Sequential Logic: Introduction, Types of Sequential circuits, Basic storage elements (Latch and Flip-flops), Characteristic equations & tables, excitation</p>	8

	table, Flip-flop conversion, Analysis and design of synchronous sequential circuits.	
3	<p>Unit 3: Registers, Shift register, Universal shift register, Counters (Ripple & Synchronous): Introduction & Design, Introduction to memory, types of memory, PLD: PAL, PLA, ROM</p> <p>Introduction to Computer Organization & Architecture, Von Neumann and Harvard Architecture, RISC and CISC machines, Evolution of Intel x86 and ARM architecture, Basic measures of computer performance, Amdahl's Law, Little's Law.</p>	10
4	<p>Unit 4: Computer Arithmetic (Integer and Floating Point): Representation, Addition, Subtraction, Multiplication and Division. Machine Instruction characteristics, Addressing Modes, Processor structure and operation, Instruction Cycle, Instruction Pipelining: Strategy, performance, Hazards. Control unit operation and microprogrammed control.</p>	10
5	<p>Unit 5: Memory hierarchy: Locality and performance, Cache memory: Principles and elements of design, Internal memory, External memory, I/O interface: External devices, I/O modules, Programmed I/O, Interrupt driven I/O, Direct Memory Access. Introduction to alternative architectures.</p>	10
	Total	48

11. Suggested Books:

S.No	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	M. Morris Mano, Digital Logic and Computer Design, Pearson	1 st	2016
2.	W. Stalling, Computer Organization and Architecture, Pearson	11 th	2022
	Reference Books		
1.	Charles H. Roth Jr., Fundamentals of Logic Design, Wadsworth Publishing	5 th	2005
2.	John P Hayes, Computer Architecture and Organization, McGraw Hill	3 rd	2017

12.	Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam
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Graphic Era Hill University, Dehradun

SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code:	TCS 302	Course Title:	Data structures with C
2. Contact Hours:	L: 3	T: 0	P: 0
3. Examination Duration (Hrs):	Theory 3	Practical	0
4. Relative Weight:	CIE 25	25	SEE 50
5. Credits:	3		
6. Semester:	III		
7. Category of Course:	DC		
8. Pre-requisite:			

9. Course Outcome**:	<p>After completion of the course the students will be able to:</p> <p>CO1: Describe the concept of Data Structures and assess how the choice of data structures impacts the performance of programs</p> <p>CO2: Compare and contrast merits and demerits of various data structures in terms of time and memory complexity.</p> <p>CO3: Identify and propose appropriate data structure for providing the solution to the real world problems.</p> <p>CO4: Implement operations like searching, insertion, deletion, traversing mechanism etc. on various data structures</p> <p>CO5: Be familiar with advanced data structures such as balanced search trees, hash tables, AVL trees, priority queues, ADT etc.</p> <p>CO6: To augment merits of particular data structures on other data structure to develop innovation in subject of study.</p>
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**** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.**

10. Details of the Course:

SL. NO.	Contents	Contact Hours
1	Unit 1: Introduction: Basic Terminology, Pointer and dynamic memory allocation, Elementary Data Organization, Data Structure operations, Algorithm	10

	Complexity and Time-Space trade-off Arrays: Array Definition, Representation and Analysis, Single and Multidimensional Arrays, address calculation, application of arrays, Array as Parameters, Ordered List, Sparse Matrices. Stacks: Array. Representation and Implementation of stack, Operations on Stacks: Push & Pop, Array Representation of Stack, Linked Representation of Stack, Operations Associated with Stacks, Application of stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. Recursion: Recursive definition and processes, recursion in C, example of recursion, Tower of Hanoi Problem, tail recursion.	
2	<p>Unit 2:</p> <p>Queues: Array and linked representation and implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty. Circular queue, Dequeue, and Priority Queue.</p> <p>Linked list: Representation and Implementation of Singly Linked Lists, Two-way Header List, Traversing and Searching of Linked List, Overflow and Underflow, Insertion and deletion to/from Linked Lists, Insertion and deletion Algorithms, Doubly linked list, Linked List in Array, Polynomial representation and addition, Generalized linked list.</p>	10
3	<p>Unit 3:</p> <p>Trees: Basic terminology, Binary Trees, Binary tree representation, algebraic Expressions, Complete Binary Tree. Extended Binary Trees, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees. Traversing Threaded Binary trees, Huffman algorithm & Huffman tree.</p> <p>Searching and Hashing: Sequential search, binary search, comparison and analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation</p>	9
4	<p>Unit 4:</p> <p>Sorting: Insertion Sort, Bubble Sorting, Quick Sort, Two Way Merge Sort, Heap Sort, Sorting on Different Keys, Practical consideration for Internal Sorting.</p> <p>Binary Search Trees: Binary Search Tree (BST), Insertion and Deletion in BST, Complexity of Search Algorithm, Path Length, AVL Trees</p>	9
5	<p>Unit 5:</p> <p>File Structures: Physical Storage Media File Organization, Organization of records into Blocks, Sequential Files, Indexing and Hashing, Primary indices, Secondary indices, B+ Tree index Files, B Tree index Files, Indexing and Hashing Comparisons, Graph, Traversal(DFS,BFS) ,Minimum spanning tree</p>	8
	Total	46

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
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	Textbooks		
1.	Horowitz and Sahani, "Fundamentals of data Structures", Galgotia Publication Pvt. Ltd., New Delhi.	2 nd	2008
2	R. Kruse etal, "Data Structures and Program Design in C", Pearson Education Asia,	2 nd	2006
3	A. M. Tenenbaum, "Data Structures using C & C++", Prentice-Hall of India Pvt. Ltd., New Delhi.	2 nd	2014
4	K Loudon, "Mastering Algorithms with C", Shroff Publisher & Distributors Pvt. Ltd.	1 st	2000
5	Bruno R Preiss, "Data Structures and Algorithms with Object Oriented Design Pattern in C++", Jhon Wiley & Sons, Inc.	1 st	1998
6	Adam Drozdek, "Data Structures and Algorithms in C++", Thomson Asia Pvt	4 th	2013

12.	Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam
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Graphic Era Hill University, Dehradun

SEMESTER III

Name of Department: - Computer Science and Engineering

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|--------------------------------|-------------------------------|---------------|---------------------------------------------|
| 1. Subject Code: | TCS 307 | Course Title: | Object Oriented Programming with C++ |
| 2. Contact Hours: | L: 3 | T: 0 | P: 0 |
| 3. Examination Duration (Hrs): | Theory 3 | Practical | 0 |
| 4. Relative Weight: | CIE 25 | MSE 25 | SEE 50 |
| 5. Credits: | 3 | | |
| 6. Semester: | III | | |
| 7. Category of Course: | DC | | |
| 8. Pre-requisite: | Subject Name with Code | | |

9. Course Outcome**:	<p>After completion of the course the students will be able to:</p> <p>CO1: Demonstrate the C++ Program uses data types, operators, expressions, array, strings and functions.</p> <p>CO2: Implement Constructors (Parameterized, Copy), this pointer, friend function, dynamic objects, arrays of objects.</p> <p>CO3: Illustrate the Operator Overloading of +, -, preincrement, postincrement, << and >>.</p> <p>CO4: Implement the single, multiple, multilevel and hybrid inheritance in C++.</p> <p>CO5: Illustrate function overloading, Overriding and virtual functions.</p> <p>CO6: Carry out exception handling techniques and provide solutions to storage related problems using STL.</p>
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**** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.**

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	<p>Unit 1:</p> <p>Introduction: Need of object-oriented programming, Overview of C++, Header Files and Namespaces, Sample C++ program, Different data types, operators, expressions, and statements, arrays and strings, pointers & user-defined types function components, argument passing, inline functions, recursive functions.</p>	10

2	<p>Unit 2: Classes & Objects: Class Specification, Objects, Scope resolution operator, Access members, defining member functions, Data hiding, Constructors, Parameterized constructors, Destructors, Static data members, Friend functions, passing objects as arguments, Returning objects, Arrays of objects, Dynamic objects, Pointers to objects, Copy constructors, This Pointer. Operator overloading: Fundamentals of Operator Overloading, Overloading Binary Operators and unary operators, Operator overloading using friend functions such as +, -, pre-increment, post-increment, overloading of << and >>.</p>	9
3	<p>Unit 3: Inheritance: Necessity of inheritance, Types of inheritance with examples, Base Class and Derived class, Public, private and protected access modifiers, inheriting multiple base classes, working of Constructors and Destructors in Inheritance, Passing parameters to base class constructors, Virtual base classes</p>	9
4	<p>Unit 4: Virtual functions and Polymorphism: Polymorphism, function overloading, Overriding Methods, Virtual function, Calling a Virtual function through a base class reference, Pure virtual functions, Abstract classes, Virtual Destructors, Early and late binding</p>	9
5	<p>Unit 5: I/O System Basics and STL: C++ stream classes, I/O manipulators, fstream and the File classes, basic file operations, function templates Exception Handling: Exception handling fundamentals, Throwing an Exception, Catching an Exception, Re-throwing an Exception, An exception example. STL: An overview, containers, vectors, lists, maps, Algorithms</p>	9
	Total	46

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	Herbert Schildt, The Complete Reference C++, McGraw Hill	4 th	2017
2	Balagurusamy E, Object oriented Programming with C++	8 th	2020
	Reference Books		
1.	Paul Deitel and Harvey Deitel, C++: How to Program, Pearson	10 th	2016

12.	Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam
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Graphic Era Hill University, Dehradun

SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code: **TMA 316**

Course Title:

**Discrete Structures and
Combinatorics**

2. Contact Hours: L: **3**

T: **1**

P: **0**

3. Examination Duration (Hrs):

Theory **3**

Practical **0**

4. Relative Weight: CIE **25**

MSE **25**

ESE **50**

5. Credits: **4**

6. Semester: **III**

7. Category of Course: **DC**

8. Pre-requisite: TMA101 Engineering Mathematics-I

TMA201 Engineering Mathematics-II

9. Course Outcome**:	<p>After completion of the course the students will be able to:</p> <p>CO1: Be able to specify and manipulate basic mathematical objects such as sets, functions, and relations . Demonstrate an understanding of partial order relations and Lattices.</p> <p>CO2: Understand the basics of discrete probability and number theory, and be able to apply the methods from these subjects in problem solving.</p> <p>CO3: Produce convincing arguments, conceive and/or analyze basic mathematical proofs and discriminate between valid and unreliable arguments.</p> <p>CO4: Discriminate, identify and prove the properties of groups and subgroups</p> <p>CO5: Be able to apply basic counting techniques to solve combinatorial problems</p> <p>CO6: Demonstrate different traversal methods for trees and graphs. Model problems in Computer Science using graphs and trees.</p>
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**** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.**

10. Details of the Course:

SL. NO.	Contents	Contact Hours
1	Unit 1: Relations and Functions: Review of Sets,	11

	Relations - properties, equivalence relation, matrix and Graph representation, Closure operations Functions, Types of functions, Invertability, Composition of functions and Inverse functions, Partially ordered Sets and Lattices. Lattice Properties, Lattices as Boolean Algebra	
2	Unit 2: Probability Theory Basics of Probability, Conditional Probability; Random Variables, probability mass and density function, commutative distribution function, expected values, mean, variance and standard deviation, Distributions: Binomial. Poisson, normal, uniform,, exponential,	9
3	Unit 3: Fundamentals of Logic: Basic Connectives and Truth Tables, Logical Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. The Use of Quantifiers, Methods of Proof: Different methods of proof – Direct Proof, Indirect Proof, Counter examples, Principle of Induction.	9
4	Unit 4: Groups: Definitions, Examples, and Elementary Properties, Homomorphism, Isomorphism, permutation groups and cyclic Groups, subgroups, cosets, and Lagrange’s Theorem Counting: Set cardinality and counting, Sum and Product Rules, Inclusion Exclusion Principles, Pigeonhole principle, permutations and combinations, Basics of recurrence relations and, generating Functions	10
5	Unit 5: Graphs and Trees Fundamentals of Graphs Graph types – undirected, directed, weighted; - Representing graphs and graph isomorphism -connectivity-Euler and Hamilton paths, Isomorphism Tree properties, traversal techniques;	9
	Total	48

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	Kenneth H. Rosen:” Discrete Mathematics and its Applications”, , McGraw Hill,.	6 th Edition	2007
2	JayantGanguly: “A Treatise on Discrete Mathematical Structures”, Sanguine-Pearson,.	2 nd	2011
	Reference Books		
1.	D.S. Malik and M.K. Sen: “Discrete Mathematical Structures: Theory and Applications”, Thomson,.	2 nd	2004
2	Thomas Koshy:” Discrete Mathematics with Applications”, Elsevier,.	1 st	2005, Reprint 2008
3	Ralph P. Grimaldi:” Discrete and Combinatorial Mathematics” Pearson Education,.	5 th	2004

4	S.B.Singh, Jaikishor and Ekata, "Discrete Mathematics", Khanna Publication,	3 rd	2011
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12.	Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam
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Graphic Era Hill University, Dehradun

SEMESTER III

Name of Department: - Computer Science and Engineering

Mathematical Foundations
for Artificial Intelligence

1. Subject Code: **TCS-343** Course Title:
2. Contact Hours: L: **3** T: **1** P: **0**
3. Examination Duration (Hrs): Theory **3** Practical **0**
4. Relative Weight: CIE **25** MSE **25** **50**
5. Credits: **4**
6. Semester: **III**
7. Category of Course: **DC**
8. Pre-requisite: **TMA 101 Engineering Mathematics I, TMA 201 Engineering Mathematics II**

9. Course Outcome**:	<p>After completion of the course the students will be able to:</p> <p>CO1: Understand the basic concepts of Linear Algebra such as System of Linear Equation, Matrices, Vector Space, Rank, etc.</p> <p>CO2: Understand the basic principles of probability, Bayes theorem, understand the definitions of discrete, continuous, and joint random variables, compute the mean, variance and covariance of random variables.</p> <p>CO3: Solve problems on matrix decompositions such as Cholesky Decomposition, Eigen Decomposition and Diagonalization, Singular Value Decomposition</p> <p>CO4: Describe the vector calculus concepts such as differentiation of Univariate Function, Partial Differentiation and Gradients.</p> <p>CO5: Analyze various mathematical concepts, that are required to build AI & ML models.</p> <p>CO6: Create an AI & ML models by applying the concepts of mathematics such as Linear Algebra, Analytical Geometry, Matrix, Calculus, Probability, etc.</p>
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**** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate**

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	Unit 1: Linear Algebra: System of Linear Equation, Matrices, Solving system of Linear Equation, Vector Spaces, Linear Independences, Basis and Rank, Linear Mappings, Affine Space.	10

2	Unit 2: Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal basis, Orthogonal Compliment, Inner Product of Function, Orthogonal Projections, Rotations.	10
3	Unit 3: Matrix Decomposition Determinant and Trace, Eigen Values and Eigen Vectors, Choleskey Decomposition, Eigen Decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Pylogency	10
4	Unit 4: Vector Calculus Differentiation of Univariate Function, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Linearization and Multivariate Taylor Series	10
5	Unit 5: Probability and Distribution Discrete and Continuous Probability, Sum Rule, Product Rule, Bayes' Theorem, Gaussian Distribution, Change of Variables/Inverse Transform	10
	Total	50

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	Marc Peter Deisenroth , A. Aldo Faisal, Cheng Soon Ong, MATHEMATICS FOR MACHINE LEARNING, Cambridge University Press	1 st	2020
2.	Jay Dawani, Hands-On Mathematics for Deep Learning: Build a solid mathematical foundation for training efficient deep neural networks, Packt Publishing Limited	1 st	2020
	Reference Books		
1.	Tamoghna Ghosh , Shravan Kumar Belagal Math, Practical Mathematics for AI and Deep Learning, BPB Publications	1 st	2022

12.	Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam
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Graphic Era Hill University, Dehradun

SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS 351**

Course Title: **Fundamental of Cloud Computing and Bigdata**

2. Contact Hours: L: **3** T: P:

3. Examination Duration (Hrs): Theory Practical

4. Relative Weight: CIE **25** MSE **25** SEE **50**

5. Credits: **3**

6. Semester: **III**

7. Category of Course: **DE**

8. Pre-requisite: NA

9. Course Outcome**:	<p>After completion of the course the students will be able to:</p> <p>CO1: Identify the importance of cloud computing services for the digital ag technologies.</p> <p>CO2: Differentiate the services and deployment models of cloud computing.</p> <p>CO3: Evaluate the case studies of the different types of cloud computing applications.</p> <p>CO4: Analyze the cloud computing services management techniques, providers, and standards.</p> <p>CO5: Distinguish the cloud computing services using Bigdata and big data analytics</p> <p>CO6: Design and deploy a cloud based web application.</p>
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**** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.**

10. Details of the Course:

Sl. No	Contents	Contact Hours
1	<p>Unit 1: Introduction to Cloud Computing, Vision, History, Evolution, and Characteristics of Cloud Computing (NIST), Characteristic, Advantages and Disadvantages of Clou</p>	9

	Computing, Cloud computing vs. Cluster computing vs. Grid computing, Importance of Open Standards for digital age technologies.	
2	<p>Unit 2: Working of Cloud Computing, Cloud Computing comparison with traditional computing architecture (client/server), Impact of Networks, Web Development and User Interface (UI) on Cloud computing. Cloud Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud.</p>	9
3	<p>Unit 3: Cloud Service Models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). Infrastructure as a Service (IaaS): IaaS definition, Virtualization, Hypervisors, Machine Image, Virtual Machine (VM), Resource Virtualization, Server, Storage, Networking, Virtual Machine (resource) provisioning and manageability, Data centre physical plant/building, Networking firewalls/security, Data storage in cloud computing (storage as a service), Amazon Elastic Compute Cloud (EC2), Eucalyptus Open Stack, Case Study of IaaS. Platform as a Service (PaaS): PaaS definition, Service Oriented Architecture (SOA), Cloud Platform and Management, Development tools, database management, business analytics, Operating systems, Google App Engine, Microsoft Azure, and Salesforce Case Study of PaaS. Software as a Service (SaaS): SaaS definition, Web services, Web 2.0, Case Study of SaaS.</p>	9
4	<p>Unit 4: Introduction to Big Data, Characteristics, Architectures, Technologies, Applications, Advantages and Disadvantages of Big Data, Tools and Techniques applied in Big Data, Association rule learning, Classification tree analysis, Genetic algorithms, Machine learning, Regression analysis, Sentiment analysis, Social network analysis, Differences between big data and big data analytics. Introduction to Big Data analytics, Data Analysis Techniques: A/B testing, Data fusion and data integration, Data mining, Machine learning, Natural language processing (NLP), Statistics. Case study of Big Data.</p>	9
5	<p>Unit 5: Foundations Services of AWS: Savings, Security, Compliance and DRaaS, Development Operations. AWS Services: Amazon Lambda, Amazon Relational Database Service (Amazon RDS), Amazon S3, Amazon CloudFront, Amazon Glacier and Amazon SNS. Service Management in Cloud Computing: Service Level Agreements (SLAs), Billing & Accounting. Economics of Cloud Computing: SWOT Analysis and Value Proposition, General Cloud Computing Risks, (Performance, Network Dependence, Reliability, Outages), Safety Critical Processing Compliance and Information Security. Design and Deploy an Online Video Subscription Application on the Cloud.</p>	9
	Total	45

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication Reprint
	Textbooks		
1.	Rajkumar Buyya, Cloud Computing Principles and Paradigms Wiley,	1 st	2013
2	Kannammal, Fundamentals of Cloud Computing, Cengag Learning,	1 st	2015
3	Cloud Computing Bible, Barrie Sosinsky, Wiley-India,	1 st	2011
	Reference Books		
1.	Jared Dean, Bigdata Data Mining and Machine Learning Wiley,	1 st	2014
2	Vince Reynolds, Bigdata for Beginners, Create spac Independent Publishing Platform,	1 st	2016
12.	Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam	

Graphic Era Hill University, Dehradun

SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code: Course Title:
2. Contact Hours: L: T: P:
3. Examination Duration (Hrs): Theory Practical
4. Relative Weight: CIE MSE SEE
5. Credits:
6. Semester:
7. Category of Course:
8. Pre-requisite: NA

9. Course Outcome**:	<p>After completion of the course the students will be able to:</p> <p>CO1: Classify security vulnerabilities involved in data communication over Internet and make use of classical algorithms to address the vulnerabilities.</p> <p>CO2: Apply symmetric block ciphers to secure data transmission and storage</p> <p>CO3: Analyze the various public key cryptographic systems and usage of hashing</p> <p>CO4: Appreciate the design of Public Key algorithms, mathematical background and make use of the same for data communication and message authentication</p> <p>CO5: Categorize types of viruses, worms, intrusion and decide measures to counter threats.</p> <p>CO6: Understand the legal aspects related to Cybercrime, Intellectual Property, Privacy, Ethical Issues.</p>
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** Describe the specific knowledge, skills or competencies the students are expected to acquire or demonstrate.

10. Details of the Course:

Sl. No.	Contents	Contact Hours
1	Unit – 1: Introduction: Computer Security Concepts: The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, a Model for Network Security, Standards Cryptography fundamentals and terminology; Cryptanalysis and Brute-Force Attack, Fundamental techniques of cryptography Substitution and Transposition; Classical Ciphers; Basics of Steganography.	8
2	Unit – 2: Modern Cryptography: Symmetric Encryption and Message Confidentiality:	9

	Symmetric Encryption Principles, Fiestal structure. Symmetric Block Encryption Algorithms, Simple DES, double DES, Stream Ciphers and RC4, Random and Pseudorandom Numbers.	
3	Unit – 3: Symmetric key distribution using symmetric encryption: A Key Distribution Scenario, Session Key Lifetime, A Transparent Key Control Scheme, Decentralized Key Control, Controlling Key Usage Mathematical Background for cryptography: prime number, Euclidean algorithm for GCD, Extended Euclidean algorithm for multiplicative inverse, Euler's totient function, their programming implementation.	10
4	Unit 4: Public-Key Cryptography: Public-Key Encryption Structure, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptography, The RSA Public-Key Encryption Algorithm. Message Authentication: Approaches to Message Authentication, Authentication Using Conventional Encryption, Message Authentication without Message Encryption, MD5 Hash Algorithm.	9
5	Unit 5: System Security: Intruders, Intrusion Detection, Password Management, Types of Malicious Software, Viruses, Virus Countermeasures, Worms and Principles of Firewalls Legal and Ethical Aspects: Cybercrime and Computer Crime, Intellectual Property, Privacy, Ethical Issues.	8
	Total	44

11. Suggested Books:

SL. No.	Name of Authors/Books/Publishers	Edition	Year of Publication / Reprint
	Textbooks		
1.	William Stallings, Network Security Essentials Applications and Standards, ,Pearson Education,	6 th	2018
2	William Stallings , Cryptography and Network Security, Pearson Education,	7 th	2017
	Reference Books		
1.	Behrouz Forouzan , Cryptography and Network Security, McGraw Hill,	3 rd	2015
2	Atul Kahate, "Cryptography and Network Security", McGraw Hill Education,,	3 rd	2017

12.	Mode of Evaluation	Test / Quiz / Assignment / Mid Term Exam / End Term Exam
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Graphic Era Hill University, Dehradun

SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code: Course Title:
2. Contact Hours: L: T: P:
3. Examination Duration (Hrs): Theory Practical
4. Relative Weight: CIE MSE ESE
5. Credits:
6. Semester:
7. Category of Course:
8. Pre-requisite: Fundamental of Computer & Introduction to Programming (TCS101), Programming for problem solving (TCS201)

9. Course Outcome:	<p>After completion of the course, the students will be able to:</p> <p>CO1: Identify and describe the fundamental data types and basic operators used in Python programming.</p> <p>CO2: Explain the purpose and usage of functions in Python, including parameters, return values, and modules.</p> <p>CO3: Apply data structures like lists, tuples, and dictionaries to organize and manipulate data for engineering problems.</p> <p>CO4: Analyze the differences between object-oriented programming concepts like inheritance, polymorphism, and encapsulation, and their impact on program design.</p> <p>CO5: Evaluate the suitability of various libraries like NumPy, Pandas, Matplotlib, and Seaborn for specific tasks related to numerical computing, data analysis, and visualization in engineering applications.</p> <p>CO6: Design and implement Python programs using fundamental concepts, data structures, and libraries to solve basic engineering problems involving data cleaning, analysis, and visualization.</p>
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10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	<p>UNIT 1: Python Basics and Functions and Modules</p> <p>Syntax and Semantic Basics: Data types: strings, integers, floats, Variable assignments and expressions, Basic input/output operations</p> <p>Defining and calling functions: Function parameters and return values- Using built-in modules, Creating and using custom modules, Exception handling basics</p>	10
2	<p>UNIT 2: Data Handling</p> <p>Lists: creation, indexing, slicing, and methods</p> <p>Tuples: usage and when to use</p> <p>Dictionaries: creating, accessing, and manipulating</p> <p>Reading from and writing to files: text and binary files</p>	8
3	<p>UNIT 3: Object-Oriented Programming</p> <p>Introduction to classes and objects, Attributes and methods, Inheritance: extending classes</p> <p>Polymorphism: using a unified interface</p> <p>Encapsulation: private and public members</p>	10
4	<p>UNIT 4: Libraries for AI/ML</p> <p>NumPy: arrays, array operations, indexing, reshaping</p> <p>Pandas: DataFrame operations, indexing, merging, grouping</p> <p>Matplotlib: basic plotting, figures, and axes</p> <p>Seaborn: statistical data visualization</p>	10
5	<p>UNIT 5: Intro to Data Science</p> <p>Data cleaning techniques, Exploratory data analysis (EDA): summary statistics, correlation, Visualization techniques: histograms, scatter plots, box plots</p>	8
	Total	46

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Eric Matthes	Python Crash Course: A Hands-On, Project-Based Introduction to Programming	3 rd Edition	No Starch Press, USA	2023
Mark Lutz	Learning Python	5th Edition	O'Reilly Media, USA	2013
Wes McKinney	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython	2nd Edition	O'Reilly Media, USA	2017

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Joel Grus	Data Science from Scratch: First Principles with Python	2nd Edition	O'Reilly Media, USA	2019
Al Sweigart	Automate the Boring Stuff with Python: Practical Programming for Total Beginners	2nd Edition	No Starch Press, USA	2019

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SEMESTER III

Name of Department: - Computer Science and Engineering

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|----|-----------------------------|----------------------------------------------------------------|--------------------|---------------------------------------------------------------------|
| 1. | Subject Code: | TCS364 | Course Title: | Fundamentals of Artificial Intelligence and Machine Learning |
| 2. | Contact Hours: | L: 3 | T: 0 | P: 0 |
| 3. | Examination Duration (Hrs): | Theory 3 | Practical 0 | |
| 4. | Relative Weight: | CIE 25 | MSE 25 | ESE 50 |
| 5. | Credits: | 3 | | |
| 6. | Semester: | III | | |
| 7. | Category of Course: | DSC | | |
| 8. | Pre-requisite: | Fundamental of Computer & Introduction to Programming (TCS101) | | |

9. Course Outcome:	<p>After completion of the course, the students will be able to:</p> <p>CO1: Define Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning, and differentiate between them.</p> <p>CO2: Explain problem-solving frameworks in AI and describe search strategies like breadth-first, depth-first, and A*.</p> <p>CO3: Choose appropriate classification techniques like Logistic Regression, KNN, or SVM based on specific data characteristics.</p> <p>CO4: Compare and contrast different performance metrics like accuracy, precision, recall, and F1-score for evaluating ML models.</p> <p>CO5: Evaluate the strengths and limitations of specific unsupervised learning techniques like K-means and hierarchical clustering for a given task.</p> <p>CO6: Design a simple machine learning pipeline involving data pre-processing, model selection, and evaluation for a classification task.</p>
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10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	<p>UNIT 1: Overview of AI and Intelligent Agents Definition and history of AI, Differences between AI, ML, and deep learning, Applications and impact of AI in various sectors, Agents and environments, Types of agents (simple reflex, model-based, goal-based, utility-based), Agent architecture and environments Problem Solving: Problem-solving frameworks, Search strategies: breadth-first, depth-first, A* Heuristics: designing and applying heuristics</p>	9
2	<p>UNIT 2: Knowledge and Reasoning Knowledge-based AI, Logic and Reasoning: propositional and predicate logic, Inference in first-order logic, Building knowledge bases. Uncertainty Handling: Probabilities and Bayesian networks, Decision making: Expected utility- Markov decision processes</p>	9
3	<p>UNIT 3: Introduction to ML and Data Preprocessing What is Machine Learning? Types of Machine Learning: Supervised, Unsupervised, Reinforcement- ML in practice: Applications and case studies, Importance of data preprocessing, Data cleaning, normalization, and transformation, Feature selection, and dimensionality reduction. Regression Analysis Linear regression, Polynomial regression, Regularization methods: Ridge, Lasso</p>	10
4	<p>UNIT 4: Classification Techniques Logistic regression, K-nearest neighbors (KNN), Support vector machines (SVM) Decision Trees and Random Forests Building decision trees, Overfitting and pruning, Ensemble methods: Random Forests and boosting</p>	10
5	<p>UNIT 5: Evaluation of ML Models and Clustering and Association Training and testing data splits, Performance metrics: accuracy, precision, recall, F1-score, Confusion matrix and ROC curves K-means clustering, Hierarchical clustering, Apriori algorithm for association rule learning</p>	10
	Total	48

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Stuart Russell and Peter Norvig	Artificial Intelligence: A Modern Approach	4th Edition	Pearson Education Limited, USA	2024
Melanie Mitchell	Introduction to Artificial Intelligence	2nd Edition	McGraw-Hill Education, USA	2024
Tom M. Mitchell,	Machine Learning	1st Edition	Mc Graw Hill Publisher	2017
Manaranjan Pradhan, U Dinesh Kumar	Machine Learning using Python	1 st Edition	Wiley, India	2017

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Richard E. Neapolitan and Kevin Goda	Artificial Intelligence: Foundations and Applications	4th Edition	Elsevier Science & Technology, Netherlands	2024
Aurélien Géron	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow	2nd Edition	O'Reilly Media, Inc., USA	2024
E. Alpaydin,	Introduction to Machine Learning	3 rd Edition	PHI Publisher	2015

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SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS-324** Course Title: **Information Security Foundations**
2. Contact Hours: L: **3** T: **1** P: **0**
3. Examination Duration (Hrs): Theory **4** Practical **0**
4. Relative Weight: CIE **25** MSE **25** ESE **50**
5. Credits: **3**
6. Semester: **3**
7. Category of Course: **DSE**
8. Pre-requisite: **Fundamental of Computers (TCS 101), Programming for problem solving (TCS 201)**

9. Course Outcome:	After completion of the course the students will be able to: CO1: Explain symmetric and asymmetric key cryptosystems. CO2: Know the working of cryptography techniques. CO3: Analyze the different types of cryptosystems. CO4: Use cryptographic techniques to implement information security protocols. CO5: Apply cryptographic techniques in different applications. CO6: Develop symmetric and asymmetric key cryptosystems.
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10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	<p>Unit 1: Introduction to information security What is information security, why we need information security, the zero trust model, overview of ethical hacking Protection against- unauthorized modification, unauthorized deletion and unauthorized access, different types of user authentication techniques, access control techniques Pillars of information security - confidentiality, availability and integrity Steps to fix a cybercrime - Identify cyber threats, analyze and evaluate threat, treatment Type of hackers - white hat, grey hat, black hat Penetration testing and its phases - reconnaissance, scanning, gaining access, maintaining access, covering tracks. SSL and Transport layer security.</p>	10
2	<p>Unit 2: Basics of cryptography What is cryptography, what is confidentiality, data integrity, authentication, and nonrepudiation, applications of cryptography - chip based payment cards, digital currencies, computer passwords, digital communications, plaintext, cipher-text, cipher - characteristics of a good cipher, encryption, decryption, Key - significance of key length, symmetric and asymmetric key cryptography, cryptanalysis, OSI security architecture- security attacks, security services, security mechanisms</p>	10
3	<p>Unit 3: Mathematics applied in information security Concept of divisibility, prime numbers, importance of prime numbers in cryptography, euclid theorem for GCD, extended euclidean algorithm, modular arithmetic, random number generators, deterministic and nondeterministic random number generators, XOR, bit shifts, euler's totient theorem, chinese remainder theorem.</p>	8

4	Unit 4: Symmetric key cryptosystem Secret Key (symmetric) cryptography - stream and block ciphers, additive and multiplicative ciphers, rail fence technique, playfair cipher, hill cipher, vernam cipher, Vigenère Cipher, RC4 algorithm, DES, 2DES, 2-3DES, 3DES, AES, block cipher modes of operations.	10
5	Unit 5: Asymmetric key cryptosystem, digital signature, and message integrity RSA, Diffie Hellman key exchange protocol, Elliptic curve cryptography (ECC), ElGamal encryption system. DSS algorithm, RSADS algorithm, ECDSA algorithm, Message integrity, hash functions, MAC functions, HMAC	8
	Total	46

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
William Stallings	Cryptography and Network Security: Principles and Practice	8 th	Pearson Publication, India	2020

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies	Security in Computing", 5th Edition	5 th	Prentice Hall, India	2015
William Stallings	Network Security Essentials: Applications and Standards	6 th	Prentice Hall, India	2016

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SEMESTER III

Name of Department: - Computer Science and Engineering

1. Subject Code: **TCS-344** Course Title: **Probability and Random Processes**
2. Contact Hours: L: **3** T: **1** P: **0**
3. Examination Duration (Hrs): Theory **4** Practical **0**
4. Relative Weight: CIE **25** MSE **25** ESE **50**
5. Credits: **3**
6. Semester: **3**
7. Category of Course: **DSE**
8. Pre-requisite: **(TMA 101) Engineering Mathematics I, (TMA 201) Engineering Mathematics II**

9. Course Outcome:	After completion of the course the students will be able to: CO1: To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering. CO2: To understand the basic concepts of probability, one-dimensional and two-dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon. CO3: To understand the basic concepts of random processes which are widely used in IT fields. CO4: To understand the concept of correlation and spectral densities. CO5: To understand the significance of linear systems with random inputs.
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10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	Unit 1: PROBABILITY AND RANDOM VARIABLES Probability – Axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.	9
2	Unit 2: TWO - DIMENSIONAL RANDOM VARIABLES distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).	9
3	Unit 3: RANDOM PROCESSES Classification Stationary process – Markov process - Markov chain - Poisson process – Random telegraph process.	9
4	Unit 4: CORRELATION AND SPECTRAL DENSITIES Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.	9
5	Unit 5: LINEAR SYSTEMS WITH RANDOM INPUTS Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.	9
	Total	45

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Oliver C. Ibe	Fundamentals of Applied Probability and Random Processes	1 st	Elsevier, Indian Reprint	2007
Peebles. P.Z.	Probability, Random Variables and Random Signal Principles	4 th	McGraw Hill Education, American	2017

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Yates. R.D. and Goodman. D.J	Probability and Stochastic Processes	3 rd	Wiley India	2021
Stark. H., and Woods. J.W	Probability and Random Processes with Applications to Signal Processing	3 rd	Pearson education india	2002