Course Code: BSIT101
Course Title: Probability and Statistics

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 30(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 50%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): BSC102, ESC105

Additional Material Allowed in ESE: Scientific Calculator and Tables of Hypothesis Testing

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	To understand the fundamentals of statistics, including measures of central tendency and dispersion.
2	To elucidate the principles of sampling theory, along with the analysis of errors using statistical tests.
3	To apply advanced statistical techniques for correlation and regression analysis.
4	To investigate the foundational concepts of probability.
5	To analyze the theoretical underpinnings of probability distributions.
6	To demonstrate decision making under uncertainty using Statistical tools.

Contents

Part-A

Unit-1 Introduction to Statistics **12(L) hrs**

Statistics: Meaning, scope, importance, and limitations. Analysis of data: Primary data and Secondary data, source of data, collection, classification, tabulation, depiction of data. Measures of Central tendency: Arithmetic, weighted, geometric mean, median and mode. Measures of Dispersion: Range, Quartile deviation, Mean deviation, Standard deviation Coefficient of variation, Skewness and Kurtosis.

Unit-2 Sampling Distribution & Testing of Hypothesis **11(L) hrs**

Sampling: Introduction and types, Hypothesis Tests: Introduction, One and two tailed tests, critical region, Confidence interval estimation, Single and two sample tests on proportion, mean and variance for large samples, Chi – Square distribution, t – distribution for small sample, F – distribution.

Part-B

Unit-3 Correlation Analysis **10(L) hrs**

Correlation Analysis: Significance and its types, Scatter diagrams, Graphic method, Karl Pearson's correlation co-efficient, Spearman's Rank correlation coefficient, Properties of Correlation. Regression analysis: Meaning, application of regression analysis, regression equations, standard error, and Regression coefficients, difference between correlation & regression analysis.

Unit-4 Theory of Probability and Probability Distributions **12(L) hrs**

Probability: Definition, basic concepts, events and experiments, random variables, expected value, types of probability, Theorems of Probability: Addition, Multiplication and Bays Theorem. Probability Distributions: Difference between frequency and probability distributions, Binomial, Poisson, and Normal distribution

Laboratory Work

Experiment No.	Experiment Title
1	Compute measures of central tendency to calculate Mean, Median, Mode (using numpy and scipy)
2	Compute measures of dispersion to Calculate Range, Variance, Standard Deviation, Coefficient of Variation.
3	Demonstrate Skewness and Kurtosis analysis
4	Perform Hypothesis Testing to conduct one-sample and two-sample t-test
5	Apply Chi-square test for goodness-of-fit or independence.
6	Compute Karl Pearson correlation coefficients and visualize with scatter plots
7	Compute Spearman Rank correlation coefficients and visualize with scatter plots
8	Fit a line using least squares (numpy.polyfit, sklearn.linear_model) and compute regression coefficients.
9	Simulate classical probability experiments to toss coin, roll die, draw cards, and compute theoretical vs experimental probabilities.
10	To implement Bayes' Theorem using real-world examples

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. "Business Statistics- MBA" by T.R. Jain and S. C Aggarwal, VK Global Publications Pvt. Ltd., 2014
2. "Probability and Statistics for Engineers and Scientists" by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, and Keying E. Ye, 2024, Ninth Edition
3. "An Introduction to Probability and Statistics" by V.K. Rohatgi & A.K. Md. E. Saleh, Wiley, (2015), 3rd Edition
4. "Statistical Methods" by S. P Gupta, Sultan Chand, Sultan Chand & Sons Publishers 2018.
5. Laboratory Manuals.

Reference Books

1. "Introduction to Probability, Statistics, and Random Processes" by Hossein Pishro-Nik, Kappa Research, LLC, 2014
2. "Introduction to Probability and Statistics for Engineers and Scientists" by S.M. Ross, Elsevier, (2014), 4th ed.

Supplementary SWAYAM Course

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 2nd Year (Information Technology)

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Introduction to Probability and Statistics	Prof. G. Srinivasan	IIT MADRAS	https://onlinecourses.nptel.ac.in/noc25_mg35/preview
2.	Introduction to Probability Theory and Statistics	Prof. S. Dharmaraja	IIT DELHI	https://onlinecourses.nptel.ac.in/noc25_ma33/preview
3.	Probability and Statistics	Prof. Somesh Kumar	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_ma49/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 2nd Year (Information Technology)

Course Code: ESIT101
Course Title: Digital Logic

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 30(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Engineering Science		

Prerequisites (if any): ESC103

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	To understand and examine the structure of various number systems and its application in digital design.
2	Utilize knowledge of number systems, codes and boolean algebra to the analysis and design of digital logic circuits.
3	Formulate and employ a Karnaugh Map to reduce boolean expressions and logic circuits to their simplest forms.
4	Identify concepts and terminology of digital logic circuits.
5	Ability to understand, analyze and design various combinational and sequential circuits.
6	To develop skill to build, and troubleshoot digital circuit.

Contents

Part-A

Unit-1 Number Systems and Codes **5(L) hrs**

Binary, Octal, Decimal, and Hexadecimal. Number base conversions, 1's, 2's, n's complements, signed Binary numbers. Binary Arithmetic, Binary codes: Weighted BCD, Gray code, Excess 3 code, ASCII – conversion from one code to another, BCD Arithmetic, Applications in error detection and data representations in digital systems.

Unit-2 Boolean Algebra and Minimization **6(L)hrs**

Boolean postulates and laws – De-Morgan's Theorem, Principle of Duality, Boolean expression – Boolean function, Minimization of Boolean expressions – Sum of Products (SOP), Product of Sums (POS), Minterm, Maxterm, Canonical forms, Conversion between canonical forms, Karnaugh map Minimization, Quine-McCluskey method - Don't care conditions.

Unit-3 Logic Gates and Families **6(L) hrs**

AND, OR, NOT, NAND, NOR, Exclusive-OR and Exclusive-NOR. Implementations of Logic Functions using gates, NAND-NOR implementations. Study of logic families like RTL, DTL, DCTL, TTL, MOS, CMOS, ECL, key characteristics and trade-offs.

Unit-4 Combinational Circuits **6(L) hrs**

Design procedure – Adders, Subtractors, Serial adder/Subtractor, Parallel adder/ Subtractor Carry look ahead adder, BCD adder, Magnitude Comparator, Multiplexer/Demultiplexer, encoder/decoder, parity checker, code converters. Implementation of combinational logic using MUX.

Part-B

Unit-5 Sequential Circuit Design **8(L)hrs**

Flip flops SR, JK, T, D and Master slave, Excitation table, Edge triggering, Level Triggering, Realization of one flip flop using other flip flops. Asynchronous/Ripple counters, Synchronous counters, Modulo-n counter, Ring Counters. Classification of sequential circuits-Moore and Mealy, Design of Synchronous counters: state diagram, Circuit implementation. Shift registers and their industrial applications.

Unit-6 Signal Conversions **8(L)hrs**

Analog & Digital signals. A/D and D/A conversion. Techniques: Weighted Resistor, R-2R Ladder type, counters Type, Dual Slope type, Successive Approximation type. Real-world application: Signal processing and IoT sensors.

Unit-7 Introduction to VHDL **6(L) hrs**

Introduction, Behavioral, Data flow, Structural Models, Simulation Cycles, Process Concurrent Statements, Sequential Statements, Loops, Functions and Procedures, Tools used for Simulation of VHDL.

Laboratory Work

Experiment No.	Experiment Title
1	Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates.
2	Construction of half/ full adder using XOR and NAND gates and verification of its operation.
3	To Study & Verify Half and Full Subtractor.
4	Realization of logic functions with the help of universal gates NAND and NOR Gate.
5	Construction of NOR gate latch and verification of its operation.
6	Verify the truth table of RS, JK, T and D flip-flops using NAND & NOR gates.
7	Design and verify the 4-Bit Serial In - Parallel Out Shift Registers.
8	Implementation and verification of decoder and encoder using logic gates.
9	Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates.
10	Design and verify the 4- Bit Synchronous/ Asynchronous Counter using JK flip flop.
11	Verify Binary to Gray and Gray to Binary conversion using NAND gates only.
12	Verify the truth table of one bit and two-bit comparator using logic gates.
13	Write and simulate VHDL codes for basic logic gates using behavioral modeling.
14	Design and simulate a half adder circuit using VHDL.
15	Implement a 2-to-1 multiplexer using VHDL.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. Morris Mano M, Michael D. Ciletti, "Digital Design", Pearson Education, 6th Edition, 2021.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage,7th Edition, 2013.
3. Floyd and Jain, "Digital Fundamentals", Pearson Education, 8th Edition, 2007.
4. Laboratory Manuals.

Reference Books

1. William Kleitz, "Digital Electronics: Principles and Applications", McGraw Hill Education, 9th Edition, 2013.
2. Thomas L. Floyd, R.P. Jain, "Digital Fundamentals", 10th Edition, 2011.
3. Charles H. Roth Jr., "Digital Systems Design Using VHDL" Cengage Learning, 3rd Edition, 2016.

Online Learning Materials

1. https://www.geeksforgeeks.org/what-is-digital-logic/ Accessed on May 16, 2025
2. https://mrcet.com/downloads/digital_notes/IT/DIGITAL%20LOGIC%20DESIGN%20(R17A0461).pdf Accessed on May 16, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Digital Electronic Circuits	Prof. Anshuman Shukla	IIT Bombay	https://onlinecourses.nptel.ac.in/noc20_ee32/preview
2	Digital System Design	Prof. Neeraj Goel	IIT Ropar	https://onlinecourses.nptel.ac.in/noc21_ee39/preview
3	Digital Circuits	Prof. Santanu Chattopadhyay	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc23_ee115/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: CIT101
Course Title: Data Structures

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 4	**Credits:** 6
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 15(T) + 60(P) = 120 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): ESC103, ESC105

Additional Material Allowed in ESE: Nil

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Analyze and compare algorithms for efficiency using Big-O notation.
2	Understand the technique of using data structures in terms of time and space.
3	Compare and classify various data structures.
4	Select appropriate data structure to solve complex engineering problem.
5	Design solution for practical problems by involving various data structures.
6	Develop mapping techniques for storing and using data in an efficient way.

Contents

Part-A

Unit-1: Algorithms and Complexity **2(L) hrs**

Various data structures and operations performed on them, Importance of algorithmic performance, Time and Space Complexities, Asymptotic Notations, Big-O Notation, Concept of Amortized Complexity.

Unit-2 Array **7(L) hrs**

Linear and multidimensional arrays and their representation, insertion, deletion and searching in arrays, Comparison of performance of Binary Search algorithm and Linear Search algorithm, Efficient storage methods for sparse matrices, Limitations of Array as a data structure, Applications of array in real life:- storing data, image processing, financial and statistical analysis, data analysis in machine learning, social media analytics; Sort the elements in an array using quicksort, mergesort and heapsort.

Unit-3 Stack **7(L) hrs**

Array implementation of stack, push and pop operations on stack, applications of stack:- managing function calls, recursion (recursive algorithms for factorial calculation, Tower of Hanoi, etc.), conversion of infix to postfix expression and its evaluation using stack data structure, balanced

parenthesis checking, implementing backtracking algorithms, handling undo/redo operations, back and forward buttons in a web browser, Matching HTML tags in web development.

Unit-4 Queue **7(L) hrs**

Implementation of linear queue using array, limitations of linear queue, importance of circular queue in terms of efficient storage of data, implementation of circular queue and performing operations of insertion and deletion in it. Concept of double-ended queue and its applications in palindrome checking, undo-redo operations, Adaptive-Steal (A-Steal) job-scheduling algorithm. Implementation of priority queue using one-way list and separate queue for each priority level.

Part-B

Unit-5 Linked List **9(L) hrs**

Implementation of a Linear linked list, insertion and deletion operations on linear linked list, implementation of circular linked list and doubly linked list, efficient searching of elements using skip list, implementation of stack using linked list, implementation of queue using linked list.

Unit-6: Trees and Graphs **9(L) hrs**

Implementation of Tree data structures, Binary Tree, Binary Search Tree, Preorder, Inorder and Postorder Tree Traversal Techniques, Skewness in Binary Search Tree, AVL trees, Threaded Trees, Multiway Trees and B-Trees, Heap Trees, Implementation of graph data structure using adjacency matrix and adjacency list, Breadth-First Search (BFS) and Depth-First Search (DFS) graph traversal techniques.

Unit-7 Hashing Techniques **4(L) hrs**

Need of hashing, Hash Functions:- Division method, mid-square method, folding method, Collision in Hashing, Collision Resolution Techniques:- Open addressing (involving Linear Probing, Quadratic Probing, Double Hashing), Closed Addressing; Rehashing.

Laboratory Work

Experiment No.	Experiment Title
1	Find the k^{th} largest and the k^{th} smallest number in an array having *n* integers in it.
2	Reverse the elements of an array and display the contents of the updated array.
3	Implement Linear Search algorithm and Binary Search Algorithm on an array and compare their performance.
4	Sort the elements of the array in ascending order using recursive quicksort algorithm.
5	Apply mergesort algorithm to sort the elements of the given array in descending order.
6	Implement stack data structure (LIFO) using array and perform push and pop operations on it.
7	Use stack data structure to solve recursive Tower of Hanoi problem involving *n* number of disks.
8	Implement linear queue data structure (FIFO) using array and perform operations of insertion and deletion on it.
9	Implement circular queue using array and compare its efficiency in storing data with that of linear queue.
10	Use a header node to point the first node of the linear linked list and perform operations of insertion and deletion in it.

11	Apply push and pop operations on stack when it is implemented using linked list.
12	Implement queue using linked list and perform the operations of insertion and deletion in it.
13	Traverse a Binary Search Tree using Preorder, Inorder and Postorder Traversals.
14	Implement MaxHeap and MinHeap trees.
15	Use Adjacency Matrix to implement a graph.
16	Represent a graph using adjacency list.
17	Apply the Breadth First Search (BFS) traversal technique on a graph with the help of queue data structure.
18	Apply Depth First Search (DFS) traversal technique on a graph with the help of stack data structure.
19	Implement a hash table using the mid-square hashing method.
20	Apply linear- probing collision resolution technique to handle collisions in the hash table.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Fourth Edition, Pearson, 2014.
2. Y. Langsam, M .J. Augenstein, A. M. Tanenbaum, "Data Structures using C and C++", Prentice Hall of India, 2016.
3. R. S. Salaria, "Data Structures (Third Edition)", Khanna Publishing House, 2021.
4. N. Karumanchi, "Data Structures and Algorithms Made Easy", Careermonk Publications, 2023.
5. Laboratory Manuals.

Reference Books

1. M. T. Goodrich, R. Tamassia, and M. H. Goldwasser, "Data Structures and Algorithms in Python", Wiley, 2021.
2. H. Jain, "Problem Solving in Data Structures & Algorithms Using C", BPB Publications, 2022.
3. J. Wengrow, (2024), "A Common-Sense Guide to Data Structures and Algorithms in Python (Grayscale Indian Edition, First Edition)", Adison Wesley, 2024.

Online Learning Materials

1. "Data Structures and Algorithms", https://www.mta.ca/~rrosebru/oldcourse/263114/Dsa.pdf
   Accessed on January 20, 2025
2. "Data Structures and Algorithms in 24 hours", https://www.professores.uff.br/
   Accessed on January 20, 2025
3. "Advance Data Structures and Algorithms", https://mrcet.com/downloads/digital_notes
   Accessed on March 15, 2025
4. "Algorithms and Data Structures", https://people.inf.ethz.ch/wirth/AD.pdf
   Accessed on March 15, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Data Structures and Algorithms	Prof. Naveen Garg	IIT Delhi	https://nptel.ac.in/courses/106102064

2	Programming, Data Structures and Algorithms Using Python	Prof. Madhavan Mukund	Chennai Mathematical Institute	https://nptel.ac.in/courses/106106145

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: CIT102
Course Title: Data Communication and Computer Networks

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 30(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): ESC103

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand Network essentials, Network Architecture, TCP/IP and OSI model.
2	Analyze and solve networking problems in the area of guided and unguided transmission media.
3	Illustrate multi - channel access protocols and IEEE 802standards for LAN and MAN.
4	Contrast the design issues and working of protocols at different layers of TCP/IP and OSI models.
5	Formulate the various congestion and routing algorithms.
6	Implement the concepts of N/W security and protocols such as HTTP, FTP, Telnet, DNS.

Contents

Part-A

Unit-1 Introduction to Computer Networks **9(L) hrs**

Introduction to Computer Networks Data Communication System and its components, Data Flow, Computer network and its goals, Types of computer networks: LAN, MAN, WAN, Wireless and wired networks, broadcast and point to point networks, Network topologies, Network software: concept of layers, protocols, interfaces and services, ISO-OSI reference model, TCP/IP reference model.

Unit-2 Physical Layer **7(L)hrs**

Concept of Signals, Bandwidth, Transmission Impairments: Attenuation, Distortion, Noise, Data rate limits : Nyquist formula, Shannon Formula, Multiplexing : Frequency Division, Time Division, Wavelength Division, Introduction to Transmission Media : Twisted pair, Coaxial cable, Fiber optics, Wireless transmission), Switching: Circuit Switching, Message Switching, Packet Switching & their comparisons.

Unit-3 Data Link Layer **7(L) hrs**

Design issues, Framing, Error detection and correction codes: checksum, CRC, hamming code, Sliding Window Protocols: Stop & Wait ARQ, Go-back-N ARQ, Selective repeat ARQ, Data link protocols: HDLC and PPP. Virtual Networks, VLAN.

Part-B

Unit-4 Medium Access Sub-Layer **6(L)hrs**

Static and dynamic channel allocation, Random Access: ALOHA, CSMA protocols, Controlled Access: Polling, Token Passing, IEEE 802.3 frame format, Ethernet cabling, Manchester encoding, collision detection in 802.3, Wireless MAC

Unit-5 Network Layer **6(L)hrs**

Design issues, IPv4 classful and classless addressing and subnetting, IPv6, Routing algorithms: distance vector and link state routing, Congestion control: Principles of Congestion Control, Congestion prevention policies, Leaky bucket and token bucket algorithms.

Unit-6 Transport Layer **6(L) hrs**

Elements of transport protocols: addressing, connection establishment and release, flow control and buffering, multiplexing and de-multiplexing, introduction to TCP/UDP protocols and their comparison.

Unit-7 Application Layer **4(L) hrs**

World Wide Web (WWW), Domain Name System (DNS), E-mail (SMTP, POP3, IMAP, MIME).

Laboratory Work

Experiment No.	Experiment Title
1	Analysis of different types of network cables and devices in detail.
2	Implementation of cross wired cable and straight through cable using crimping tool.
3	Configuring and connecting computers in LAN.
4	Establishing the basic network connectivity through switch configuration.
5	Implementation of any error detection and correction techniques.
6	Practical examination of MAC addresses and Ethernet Frame via wire Shark.
7	Configuring and analyzing classfull and classless IP addresses.
8	Analyzing IP packet flow using wire shark.
9	Implementation of various network commands.
10	Implementing and configuring DNS for Email and Web process.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. Forouzan, B.A., “Data communication and Networking”, McGraw Hill , 4th edition , 2006.
2. Tanenbaum , A.S., “Computer Networks”, Prentice Hall , 5th edition ,2010.

3. Stallings, W., "Computer Networking with Internet Protocols and Tech", Prentice Hall of India, 9th edition, 2010.
4. Laboratory Manuals.

Reference Books

1. Narasimha Karumanchi, Elements of Computer Networking: An Integrated Approach (Concepts, Problems and Interview Questions) CareerMonk Publication, 1st Edition, 2014.
2. Norman F. Schneidewind, Computer, Network, Software, and Hardware Engineering with Applications, Wiley-IEEE Press.
3. Victor Olifer , Computer Networks: Principles, Technologies and Protocols for Network Design Paperback, Wiley 2006.

Online Learning Materials

1. Computer networks book (Forouzan) https://dpvipracollege.in/wp-content/uploads/2023/01/Data-Communications-and-Networking-By-Behrouz-A.Forouzan.pdf Accessed on May 16, 2025
2. http://iips.icci.edu.iq/images/exam/Computer-Networks---A-Tanenbaum---5th-edition.pdf Accessed on May 16, 2025
3. https://www.tutorialspoint.com/computer_fundamentals/computer_networking.htm Accessed on May 16, 2025
4. https://www.geeksforgeeks.org/basics-computer-networking/ Accessed on May 16, 2025
5. https://www.studytonight.com/computer-networks Accessed on May 16, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Computer Networks And Internet Protocol	Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty	IIT Kharagpur	https://nptel.ac.in/courses/106105183
2	Communication Networks	Prof. Goutam Das	IIT Kharagpur	https://nptel.ac.in/courses/117105148

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: HSMC103
Course Title: Business Essentials for Engineers

Programme: B.Tech.	**L:** 2 **T:** 0 **P:** 0	**Credits:** 2
Semester: 3/4	**Theory/Practical:** Theory	**Teaching Hours:** 30 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: NIL		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Introduce engineering students to the fundamentals of business and management.
2	Provide an understanding of core functional areas like finance, HRM, and marketing.
3	Equip students with practical business knowledge that complements technical skills.
4	Enable students to understand the interdisciplinary nature of business in the Indian context.
5	Prepare students for managerial roles or entrepreneurial ventures.

Contents

Part-A

Unit-1 Business Landscape **7(L) hrs**

Understanding the Indian Business System, Business Environment and Its Dynamic Nature (Macro and Micro), Forms of Business Organizations in India, Introduction to management functions and level, Business Ethics and Responsibility, Need and Scope, Business in Global Context.

Unit-2 Building and Leading Teams **8(L)hrs**

Managing the Business Enterprise and its Resources, Managing Human Resources, Recruiting and Training the Workforce, Motivating, Satisfying and Leading Employees, Human Resource Management: Meaning, Importance and Functions, Performance Appraisal and Compensation, Career Development of the Employees.

Part-B

Unit-3 Financial Foundations **7(L) hrs**

Understanding Basic Accounting Principles and Financial Statements, Time Value of Money and Its Applications, Costing and Budgeting: Basic Concepts, Sources of Finance for Startups and Small and Medium Enterprises, Money and Banking, Financial Decisions, Sources of Finance and Associated Risks, Basic Concepts of Investments.

Unit-4 Marketing Strategies **8(L)hrs**

Marketing Fundamentals, Developing Products (Nature and Types of Products), Branding and Its Importance, Marketing Mix, Nature and Its Scope, Pricing Methods, Promotion and Product Distribution, Emerging Concepts in Marketing, Marketing Research and Analytics.

Text Books

1. Dr. C.B. Gupta, "Business Organization and Management" 20th Edition, Sultan Chand & Sons, 2022.
2. I.M. Pandey, "Financial Management", 12th Edition, Vikas Publishing, 2021.
3. Philip Kotler & Kevin Lane Keller, "Marketing Management", 15th Global Edition, Pearson Education, 2022.

Reference Books

1. Ebert and Griffin, "Business Essentials", 12th Edition, Pearson, 2018.

Online Learning Materials

https://archive.org/details/isbn_9780132664097/page/n5/mode/2up

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 2nd Year (Information Technology)

Course Code: MCIT101
Course Title: Environmental Sciences and Sustainability

Programme: B.Tech.	**L:** 2 **T:** 0 **P:** 0	**Credits:** 0
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 30(L) = 30 hrs
Total Max. Marks: NIL	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** NIL
Minimum Percentage of Numerical / Design / Programming Problems in ESE: NIL		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Mandatory (Non-Credit)		

Prerequisites (if any): NIL

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Identify and classify various natural resources and analyze the impact of their overexploitation on ecosystems and communities.
2	Explain the causes, effects, and control measures of major types of pollution and relate them to environmental and health concerns.
3	Evaluate the influence of Information Technology on environmental sustainability and propose responsible usage and solutions.
4	Interpret environmental laws and assess their role in addressing climate change, rehabilitation, and sustainable development.
5	Examine the environmental and health impacts of e-waste and green computing practices and recommend sustainable IT strategies.
6	Demonstrate awareness of ethical, social, and technological approaches to environmental protection and sustainable development.

Contents

Part-A

Unit-1 Natural Resources **5(L) hrs**

Renewable and non-renewable resources: Natural resources and associated problems: Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people.

Unit-2 Environmental Pollution **4(L) hrs**

Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards.

Unit-3 Impact of Information Technology on Environment and Sustainable Development **6(L) hrs**

Positive and Negative Impacts of IT for Environment, Mobile Phones and Cell Towers, SAR Levels, Effects of Mobile Radiations, Management and Control, IT Impact in Education-Health-Entertainment-Environment- Business-Society, National Management Information System, Environmental Information System, Geographical Information System, Functions of Remote Sensing, Human Health and Safety.

Part-B

Unit-4 Social issues and the Environment **6(L) hrs**

Form unsustainable to sustainable development, Water conservation, rain water harvesting, water shed management, Resettlement and rehabilitation of people; its problems and concerns, case studies, Environmental ethics: issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies, Environment protection Act, Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act, Wildlife protection act, Forest conservation act.

Unit-5 E-Wastage and Green Computing **5(L) hrs**

Impacts of E-Waste on the Environment, Harmful Effects caused by Improper Computer & Electronic Waste Recycling, Global Trade Issues, Information Security, Recycling, Repair, Electronic Waste Substances, Holistic Approaches and Techniques for Green Computing, Impacts of Green Computing, Green Awareness, Green Initiatives in Information Technology, Green Computing Certifications, Issues & Challenges Ahead.

Unit-6 Vehicle Disposal and Environmental Impact **4(L) hrs**

Environmental Concerns of Vehicle Disposal, Steps in Environmentally Sustainable Vehicle Disposal, Eco-Friendly Technologies and Practices, Challenges, Motor Vehicles Act, 1988 (Amended 2019), Vehicle Scrappage Policy (2021).

Text Books

1. Textbook of Environmental studies, Erach Bharucha, UGC,2017 Weblink: https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
2. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd, Second Edition, 2023
3. Environment Biology by Agarwal, K. C., Nidi Publ. Ltd. Bikaner 2001

Reference Books

1. Principles of Environmental Science by William P. Cunningham, Mary Cunningham, and Catherine O'Reilly, 10th Edition (2023), McGraw-Hill Education.
2. Essentials of Environmental Science by Joseph 2006 edition.
3. Perspectives in Environmental Studies by Anubha Kaushik and C.P. Kaushik, 8th Edition (2025), New Age International Publishers.
4. Elements of Environmental Science and Engineering by P. Meenakshi, 2nd Edition (2024), PHI Learning.
5. Elements of Environmental Engineering by S.K. Duggal 2007 edition.

Online Learning Materials

1. https://en.wikipedia.org/wiki/Environmental_science Accessed on May 16, 2025
2. https://www.tezu.ernet.in/denvsc/IDC/Study%20material%20Unit%201.pdf Accessed on May 16, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Environmental Science	Prof. Sudha Goel, Prof. Shamik Chowdhury	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc23_hs155/preview

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 2nd Year (Information Technology)

Course Code: LCIT103
Course Title: Object-Oriented Programming Laboratory using C++

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 4	**Credits:** 2
Semester: 3	**Theory/Practical:** Practical	**Teaching Hours:** 60 hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks: NIL**
Duration of End Semester Examination (ESE): NA		
Course Type: Core Course		

Prerequisites (if any): ESC103

The suggested practical topics should be implemented to support skill development for competitive coding platforms such as CodeNinja, CodeTantra, and others.

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply the principles of object-oriented programming such as classes, objects, encapsulation, and abstraction in C++.
2	Implement constructors, destructors, and operator overloading to manage object creation, destruction, and behavior customization.
3	Demonstrate various types of inheritance and polymorphism to promote code reuse and runtime flexibility.
4	Develop programs using advanced features such as virtual functions, abstract classes, RTTI, and type casting.
5	Apply exception handling mechanisms to develop robust and error-resilient C++ applications.
6	Perform file input/output operations and use templates and STL for creating reusable and generic code.

Contents

Experiment No.	Experiment Title
1	**Objects and Classes** a. Create a simple class with private members and public methods b. Demonstrate access specifiers with real-life examples c. Define and use arrays inside a class d. Use an array of objects e. Implement static data members and static functions f. Implement recursive member functions (e.g., factorial, Fibonacci) g. Overload a member function (e.g., area of shapes) h. Use constant and volatile member functions i. Demonstrate use of scope resolution operator j. Pass objects as function arguments (by value and by reference) k. Implement data abstraction and encapsulation in a real-world example
2	**Constructors and Destructors** a. Implement default, parameterized, and copy constructors b. Demonstrate constructor overloading with different types of arguments c. Create and use constant objects with constructors

	d. Demonstrate dynamic constructor with memory allocation e. Write a program to show the role of destructors f. Overload operators (e.g., +, = =) using member functions g. Use this pointer in a class to resolve naming conflicts h. Demonstrate friend function and friend class
3	**Inheritance** a. Implement single inheritance b. Implement multilevel and multiple inheritance c. Demonstrate hierarchical and hybrid inheritance d. Use virtual base classes to avoid diamond problem e. Demonstrate constructors/destructors in inheritance f. Override member functions in derived class g. Apply access control in inheritance (private, public, protected)
4	**Polymorphism** a. Function overloading with different argument types b. Operator overloading using non-member function c. Demonstrate runtime polymorphism with virtual functions d. Create an abstract class and implement pure virtual functions e. Implement virtual destructors and explain with base class pointers
5	**Exception Handling** a. Basic try-catch block with division by zero b. Use multiple catch blocks for different exceptions c. Demonstrate use of std::exception and its derived classes d. Create a custom exception class and use it e. Handle exceptions in constructors and destructors f. Nested try-catch and rethrowing exceptions
6	**File Handling and Templates** a. Open and write to a text file using ofstream b. Read from a text file using ifstream c. Use fstream for read/write operations d. Demonstrate file modes and error checking e. Use seekg, seekp, tellg, and tellp f. Create and use a function template g. Create and use a class template

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Reference Books

1. K R Venugopal, Rajkumar Buyya and T Ravishankar, “Mastering C++”, 2nd Edition, Tata McGraw Hill Publishing Company Ltd, 2013.
2. Balagurusamy, “Object Oriented Programming with C++”, 7th Edition, McGraw Hill, 2019.
3. Kanetkar P. Yashavant, “Let Us C++”, BPB Publications, 2nd Edition, 2019.
4. Bjarne Stroustrup, “The C++ Programming Language”, 4th Edition , Addison Wesley, 2013.
5. Herbert Schildt, C++: The Complete Reference, Mc-Graw Hill, 4th Edition, 2002.
6. Laboratory Manuals.

Online Learning Materials

1. NPTEL (Fundamentals of Object Oriented Programming) Available at https://nptel.ac.in/courses/106107574, Accessed on May 13, 2025
2. NPTEL (Programming in C++), Available at https://nptel.ac.in/courses/106105151 Accessed on May 13, 2025
3. Tutorials Point (C++ Object Oriented) Available at https://www.tutorialspoint.com/cplusplus/cpp_object_oriented.htm Accessed on April 21, 2025
4. C++ Tutorials (Object Oriented Programming) Available at https://www.studytonight.com/cpp/cpp-and-oops-concepts.php, Accessed on April 21, 2025
5. GeeksforGeeks (A computer science portal for geeks) Available at https://www.geeksforgeeks.org/basic-concepts-of-object-oriented-programming-using-c/, Accessed on April 21, 2025
6. LearnCpp.com (Tutorial to help you master C++ and Object Oriented Programming) Available at https://www.learncpp.com/ Accessed on April 21, 2025

Guru Nanak Dev Engineering College, Ludhiana

An Autonomous College under UGC Act 1956

B.Tech. 2nd Year (Information Technology)

Course Code: SMIT101
Course Title: Seminar and Technical Report Writing for Engineers

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2	**Credits:** 1
Semester: 3	**Theory/Practical:** Practical	**Teaching Hours:** 30 hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks: NIL**
Duration of End Semester Examination (ESE): NA		
Course Type: Project Work, Seminar and Internship		

Prerequisites (if any): NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Define and agree the purpose of the report.
2	Have a clear understanding of the needs of your readers.
3	Design a document structure to effectively get your message across.
4	Identify the necessary content and have an appropriate layout.
5	Use a number of readily available tools to assist with report writing.
6	Edit more competently and eliminate avoidable mistakes.

Contents

Experiment No.	Experiment Title
1	**Introduction:** Structure of technical Report, Presentation, Planning the report, Writing the first draft, Revising the first draft, Diagrams, graphs, tables and mathematics, The report layout, Headings, References to diagrams, graphs, tables and equations, Originality and plagiarism, Finalising the report and proofreading, The Summary, Proofreading.
2	**Presentation Skills:** Different ways to fight anxiety, If you don't have anything to say, If something goes wrong, If you forget something, If you make a mistake. Voice: Voice and eye contact, Perfect vs Passionate, Tempo and Time, Gestures, Contact: Facial Expression, asking questions, Things not to do, Computer does not start, Working with slides. Q&A: Recap, Filtering questions, Tough questions, You're uncomfortable with the answer, Difficult situations.
3	**LaTeX:** TeX, LaTeX, Terms regarding TeX, Custom installation with TeX Live, Tables and graphics tools, Automatic installation, Manual installation, Checking package status, External resources, The LaTeX syntax, Compilation.
4	**Text Formatting:** Spacing, Hyphenation, Quote-marks, Diacritics and accents, Margin misalignment and interword spacing, Ligatures, Slash marks, Fonts, Formatting macros, Text mode superscript and subscript, Text figures ("old style"numerals), Dashes and hyphens, Ellipsis (…), Ready-made strings.
5	**Paragraph Formatting:** Paragraph alignment, Paragraph indent and break, \paragraph line break, Line spacing, Manual breaks, Special paragraphs.
6	**Fonts:** Introduction, Font families, Available LaTeX Fonts, emphasizing text, Font encoding, Font styles, Local font selection, Arbitrary font size, finding fonts, Using arbitrary system fonts, PDF fonts and properties, List Structures.

7	**Tables:** The tabular environment, Row specification, Spanning, controlling table size, Colors, Width and stretching, Table across several pages, Partial vertical lines, vertically centered images, Footnotes in tables, Professional tables, Sideways tables, Table with legend, the eqparbox package, Floating with table.
8	**Floats, Figures and Captions:** Floats, keeping floats in their place, Captions, lists of figures and tables, Labels and cross-referencing, Wrapping text around figures, Subfloats, Wide figures in two-column documents, Custom floats, Labels in the figures, Footnotes and Margin Notes.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Reference Books

1. R.C. Sharma, Krishna Mohan, Business Correspondence and Report Writing, Tata McGraw Hill Education, 4th Edition, 2016.
2. Madhulika Jha, Shashi Bhushan, Effective Technical Communication, Cambridge University Press, 1st Edition, 2021.
3. Overleaf and LaTeX Team, LaTeX Beginner's Guide, Packt Publishing, 2nd Edition, 2021.
4. Norman Ramsey, LaTeX in 24 Hours: A Practical Guide for Scientific Writing, Springer, 1st Edition, 2020.
5. David Beer, David McMurrey, A Guide to Writing as an Engineer, Wiley, 5th Edition, 2018.
6. Donald C. Woolston, Technical Writing for Engineers and Scientists, Springer, 1st Edition, 2019.
7. Laboratory Manuals.

Online Learning Materials

1. https://www.theiet.org/media/5182/technical-report-writing.pdf Accessed on May 19, 2025
2. https://ias.ieee.org/wp-content/uploads/2023/06/2020-01-16_IET_Technical_Report_Writing_Guidelines.pdf Accessed on May 16, 2025
3. https://onlinecourses.nptel.ac.in/noc20_hs56/preview Accessed on May 16, 2025
4. https://onlinecourses.nptel.ac.in/noc24_ge37/preview Accessed on May 16, 2025
5. https://onlinecourses.nptel.ac.in/noc24_hs58/preview Accessed on May 16, 2025

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: CIT104
Course Title: Operating System

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 30(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): BSC102, ESC105

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Exemplify various types of Operating Systems, deadlocks, Process, File and Memory management.
2	Implement various deadlock scheduling algorithms.
3	Analyze and apply various memory and file management mechanisms.
4	Classify various page replacement algorithms for demand paging.
5	Use different disk scheduling algorithm for better utilization of external memory.
6	Examine the case studies of different Operating Systems to recapitulate the concepts of Operating System

Contents

Part-A

Unit-1 Introduction **6(L) hrs**

Introduction to Operating systems, Different types of operating systems - Batch, Multi-programmed, Time sharing, Real time, Distributed, Parallel. Functions of kernel and shell, General structure of Operating System, O/S services, System calls.

Unit-2 Process Scheduling and Management **8(L) hrs**

Concept of processes and threads, Process states, Process control block, Process scheduling, Types of Schedulers, Pre-emptive and Non pre-emptive scheduling, Scheduling Algorithms, Inter Process Communication, Process synchronization – Critical sections, Mutual Exclusion, Semaphores.

Unit-3 Memory Management **9(L) hrs**

Background, Overlays, Logical versus physical address space, Memory management policies, Fragmentation types, Partitioned memory managements, Paging, Segmentation, Segmentation with paging, Need of Virtual memories, Demand Paging, Page replacement Algorithms – FIFO, Optimal, LRU. Thrashing, Cause of Thrashing, Local and Global page replacement.

Part-B

Unit-4 Deadlocks **5(L) hrs**

Introduction to deadlocks, Conditions for deadlock, Resource allocation graphs, Deadlock prevention and avoidance, Deadlock detection and recovery.

Unit-5 Secondary Storage and File Management **10(L) hrs**

Disk structure, Disk scheduling – FCFS, SSTF, SCAN, C-SCAN, LOOK, CLOOK. Disk Management, Disk Formatting, Boot blocks, Bad blocks, SSD Management, Concept of files, File types, Access methods, File attributes, File operations, Allocation methods – Contiguous, Linked, Indexed. File System Architecture, Layered Architecture, Distributed File Systems, Advanced Protection Mechanisms.

Unit-6 Case Studies **7(L) hrs**

Windows, UNIX and Linux. Operating System support for cloud computing, virtualization, and containerization.

Laboratory Work

Experiment No.	Experiment Title
1	Installation process of various Operating Systems.
2	Virtualization, Installation of virtual machine software and installation of Operating System on virtual machine.
3	Overview of single user systems, network operating system and multiuser system.
4	Write a program for the simulation of following CPU scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin d) Priority
5	Write a program for the simulation of producer-consumer problem using semaphores.
6	Write a program for the simulation of Banker‘s algorithm for the purpose of deadlock avoidance.
7	Write a program for the simulation of following contiguous memory allocation techniques a) Worst-fit b) Best-fit c) First-fit
8	Write a program for the simulation of following page replacement algorithms a) FIFO b) LRU c) Optimal
9	Write a program for the simulation of following disk scheduling algorithms a) FCFS b) SCAN c) C-SCAN
10	Write a program for the simulation of following file allocation strategies a) Sequential b) Indexed c) Linked
11	To study the features of Windows and Linux operating system.
12	Execute various basic Linux commands, commands for files and directories, creating and viewing files, File comparisons, Disk related commands.
13	Basics of Shell programming, various types of shell, Shell Programming in bash.
14	Implement conditional statements, looping statement, case statements and functions in Shell programming.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. A. Silberschatz, P. B. Galvin, and G. Gagne, Operating System Concepts, 10th ed. Hoboken, NJ, USA: Wiley, 2018.
2. G. Nutt, Operating Systems Concepts. Pearson Education Ltd., 2004.
3. Laboratory Manuals.

Reference Books

1. K. Dhamdhere, Systems Programming & Operating Systems, 2nd ed. New York, NY, USA: Tata McGraw Hill, 2008.
2. A.S. Tanenbaum, Operating System Design & Implementation, 3rd ed. Upper Saddle River, NJ, USA: Pearson Education, 2006.
3. P. Bhatt and S. Chandra, An Introduction to Operating Systems Concepts & Practices. New Delhi, India: Prentice Hall of India, 2009.

Online Learning Materials

1. http://www.uobabylon.edu.iq/download/M.S%202013-2014/Operating_System_Concepts,_8th_Edition%5BA4%5D.pdf Accessed on April 10, 2025
2. http://dinus.ac.id/repository/docs/ajar/Operating_System.pdf Accessed on April 10, 2025
3. https://users.cs.utah.edu/~elb/cadbook/ Accessed on April 10, 2025
4. https://people.ee.duke.edu/~jmorizio/ece261/ Accessed on April 10, 2025
5. https://www.youtube.com/watch?v=Abld-fSxjNM Accessed on April 10, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Introduction to Operating Systems	Prof. Chester Rebeiro	IIT Madras	https://nptel.ac.in/courses/106106144
2.	Operating Systems and You: Becoming a Power User	Top Instructors	Google Career Certificates	https://www.coursera.org/learn/os-power-user

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: CIT105
Course Title: Database Management Systems

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 30(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 50%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): ESC103, LCIT103.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply fundamental knowledge of database systems, NoSQL databases,and SQL structures
2	Identify and formulate effective database designs, incorporating functional dependencies and database recovery techniques.
3	Utilize database techniques, skills, and tools, including query processing and normalization, to manage and optimize relational data.
4	Design physical and object-relational databases to support data storage, integrity, and performance requirements.
5	Analyze and apply emerging technologies such as NoSQL, cloud-based databases, and graph databases for modern data management solutions.
6	Design and implement comprehensive database solutions using modern tools and technologies to address real-world applications.

Contents

Part-A

Unit-1 Introduction to Database System **7(L) hrs**

Database Systems versus File Systems; Data Models: Relational, Hierarchical, Network, Object-Oriented; Database Languages (DDL, DML, DCL); DBMS Architecture and Users, Keys and Constraints, ER Diagrams, Enhanced ER (EER)**,** Design Issues.

Unit-2 Relational Model **7(L)hrs**

Relational Model: Relations, Attributes, Tuples, Keys; Relational Algebra and Calculus; SQL: Data Types, Queries, Joins, Sub-queries; Tables, Triggers, Views, Indexing, SQL – Basic Structures, Query Handling, Embedded SQL, Security and Authorization.

Unit-3 Relational Database Design **7(L) hrs**

Functional Dependencies, Multivalued Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF, 4NF and 5NF), Decomposition and Dependency Preservation.

Part-B

Unit-4 Transaction Management and Concurrency Control **7(L)hrs**

Transaction Management and Concurrency Control ACID properties, failure and recovery, concurrency control, serializability, two phase locking protocols, Timestamp and Validation based protocols, deadlocks, logs and logging protocol.

Unit-5 Recovery and Security **5(L)hrs**

Failure Classification, Log Based Recovery, Shadow Paging, Recovery with Concurrent Transactions, Checkpoints, Backup, and Restore, Database Security and SQL Injection Prevention

Unit-6 NoSQL Database **6(L) hrs**

Introduction to NoSQL Database, NoSQL Database Terms and Terminology, Evaluating NoSQL, Document, Key-Value, MongoDB, Use Cases in Industry (Metlife, Facebook, Google)

Unit-7 Introduction to Emerging Topics **6(L) hrs**

Real-time Databases, Streaming Data, Spatial and Multimedia Databases, Cloud-native Database Features: Scalability, Replication, Backup. AI-Ready Databases: Vector DBs and Use Cases.

Laboratory Work

Experiment No.	Experiment Title
1	**Creating and Managing Tables:** Create table statement; referencing another user's tables; the DEFAULT option; data types; alter table statement; adding a column; modifying a column; dropping a column; dropping a table; truncating a table.
2	**Writing Basic SQL SELECT Statements :** Basic SELECT Statement; selecting – all columns, specific columns; using arithmetic operators; operator precedence; using parenthesis; defining a NULL Value; using column aliases; concatenation operator; eliminating duplicate rows; displaying table structure.
3	**Restricting and Sorting Data:** Limiting rows using a selection; character strings and dates; comparison conditions; using the BETWEEN condition; IN condition; LIKE condition; NULL conditions; logical conditions- AND, OR and NOT operators; rules of precedence; ORDER BY clause; sorting – ascending, descending order.
4	**Manipulating Data:** Data manipulation language; adding a new row to a table; inserting-new rows, rows with NULL values, specific date values; updating rows in a table; updating two columns; updating rows based on another table; removing a row from a table deleting rows from a table; deleting rows based on another table.
5	**Single Row Functions:** Character functions - case manipulation and character manipulation functions; number functions, date functions; using arithmetic operators with dates; date functions, conversion functions.
6	**Displaying Data from Multiple Tables:** Cartesian products; different types of joins specific to the software package; SQL compliant joins
7	**Aggregating Data Using Group Functions:** Group functions for various statistical metrics; creating groups of data by GROUP BY clause; grouping by more than one column; excluding group results- HAVING Clause.
8	**Subqueries:** Single-row subqueries; multiple-row subqueries; using group function in a subquery; HAVING clause with subqueries; usage of operators in multiple-row subqueries
9	**Creating Views:** Simple views and complex views; creating a view; retrieving data from view; querying a view; modifying a view; removing a view; inline views.

10	**Overview of MongoDB:** A NoSQL database: Create and drop-database, collection; data types; insert document; query document; logical operators; update document; delete document; projection; limit records; sort documents.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. Abraham Silberschatz, S. Sudarshan, Henry F. Korth, "Database System Concepts", 6th Edition, Tata McGraw - Hill Education, 2011.
2. Shamkant B. Navathe, RamezElmasri, "Fundamentals of Database Systems", 6th Edition, Addison Wesley Pub Co Inc, 2010.
3. Connolly, "Specifications of Database Systems : A Practical Approach to Design, Implementation and Management", 4th Edition, Pearson India, 2008.
4. "Database Management Systems" by Raghu Ramakrishnan.
5. Laboratory Manuals.

Reference Books

1. Essentials of Data Base Management System - Alexis Leon and Mathews Leon - Vikas Publishing Limited, Chennai First Edition, 2009.
2. SQL and PL/SQL - Sharad Maheswari Ruchin Jain - Firewall Media New Delhi First Edition 2010.
3. Database Management Systems - Ramon a.Mato-Toledo, Pauline K.Cushman - Schaums'Outline series, TMH, New Delhi Special Indian Edition 2007.
4. Data Warehousing - BPB Editorial Board - BPB Publications, New Delhi - First Indian Edition 2004, Reprinted 2008.
5. Mastering Database Technologies - Ivan Bayross - BPB Publications, New Delhi - First Indian Edition 2006, Reprinted 2011.
6. Mastering Database Technologies - Ivan Bayross - BPB Publications, New Delhi - First Indian Edition 2006, Reprinted 2011.
7. Introduction to Oracle 9i:SQL by Nancy Greenberg and Priya Nathan , publisher Sheryl Dominigue edition June 2001.
8. SQL, PL/SQL: The Programming Language of Oracle by Ivan Bayross , publisher BPB, edition December 2010.

Online Learning Materials

1. Database System Concepts - 7th edition March(2019) https://db-book.com/ Accessed on May 16, 2025
2. Shamkant B. Navathe, RamezElmasri, "Fundamentals of Database Systems", 7th Edition [https://www.auhd.edu.ye/upfiles/elibrary/Azal2020-01-22-12-28-11-76901.pdf] Accessed on May 16, 2025
3. https://onlinecourses.nptel.ac.in/noc25_cs40/preview Accessed on May 16, 2025
4. https://www.studytonight.com/dbms/er-to-relational-model.php Accessed on May 16, 2025
5. https://www.studytonight.com/dbms/database-normalization.php Accessed on May 16, 2025
6. MongoDB Courses and Trainings | MongoDB University https://www.mongodb.com/docs/manual/ Accessed on May 16, 2025

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	DataBase Management System	Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc24_cs21/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: CIT106
Course Title: Web Technologies

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 30(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 50%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): ESC103, LCIT103.

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Design and structure web pages using HTML5.
2	Style and layout web content using CSS3 and Bootstrap.
3	Add interactivity to websites using JavaScript.
4	Build simple dynamic websites using PHP and MySQL.
5	Develop full web projects with form validation and CRUD operations.
6	Understanding client-server interaction in basic web applications.

Contents

Part-A

Unit-1 Introduction to Web Designing **7(L) hrs**

Basics of Web Development. Website Structure: HTML, CSS, JavaScript. Client-side vs. Server-side Overview. Static vs. Dynamic Websites. Web Development Tools: VS Code, Browsers, Developer Tools.

Unit-2 HTML5 and CSS3 - Structure of Web Pages **10(L) hrs**

HTML Document Structure. Headings, Paragraphs, Links, Images. Semantic Tags. Lists, Tables. Forms and Input Types. Embedding Multimedia: Video, Audio, iFrames. CSS Syntax, Selectors, Properties. Box Model: Margin, Border, Padding, Content.

Unit-3 JavaScript – Web Interactivity **6(L) hrs**

JavaScript Basics: Variables, Operators, Control Structures. Functions and Events. DOM Manipulation. Form Validation.

Part-B

Unit-4 Responsive Design with Bootstrap **7(L) hrs**

Bootstrap Grid System, Components: Icons, Buttons, Navigation bar, Badges, Alerts, Toolbars, Panels, Pagination, Tables, Cards, Forms.

Unit-5 Introduction to PHP **9(L)hrs**

Definition, features, server-side scripting basics, PHP installation using LAMP/XAMPP/WAMP, writing and executing simple PHP scripts, understanding PHP syntax, variables, data types, constants, output using echo and print. Control Structures. Creating and calling user-defined functions; using built-in PHP functions; file inclusion with include and require, Working with HTML Forms: Creating forms using HTML; handling form submissions using $_GET and $_POST; validating form inputs.

Unit-6 PHP and MySQL – Server-side Programming **6(L) hrs**

PHP and MySQL Database Connectivity: Introduction to MySQL database; connecting to MySQL using mysqli or PDO; executing SQL queries from PHP; performing basic CRUD operations – Insert, Read, Update, Delete; displaying data using HTML tables.

Laboratory Work

Experiment No.	Experiment Title
1	Design a basic static webpage using HTML5 to demonstrate headings, paragraphs, lists, tables, and semantic tags.
2	Develop a styled webpage using CSS3 demonstrating the box model, typography, backgrounds, and layout using Flexbox and Grid.
3	Create a responsive webpage using media queries and CSS to adapt content layout for various screen sizes.
4	Design an interactive webpage using JavaScript for DOM manipulation, control structures, and form validation.
5	Build a multipage website using Bootstrap to demonstrate responsive design using the grid system and components like navbar, cards, and forms.
6	Install and configure XAMPP/WAMP and write basic PHP scripts to display output, use variables, data types, and constants.
7	Develop a PHP script to implement control structures and user-defined functions for performing logical and arithmetic operations.
8	Create an HTML form and use PHP to handle and validate form data using $_GET, $_POST, and secure input sanitization.
9	Design a PHP web application using include() and require() for modular coding and built-in functions for date/time and string operations.
10	Build a dynamic web application using PHP and MySQL to perform CRUD operations and display data in HTML tables.

Mini Project: Student has to do a project assigned from course contents in a group of students. They must submit a project report and give a presentation of the same.

Text Books

1. A. Forbes, The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications with PHP and MySQL, CreateSpace Independent Publishing Platform, 2015.
2. R. Nixon, Learning PHP, MySQL & JavaScript: A Step-by-Step Guide to Creating Dynamic Websites, 7th ed. Sebastopol, CA, USA: O'Reilly Media, Jan. 2025.
3. Kogent Learning Solutions Inc., HTML5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, and jQuery, 2nd ed. New Delhi, India: Dreamtech Press, 2016.

4. J. Duckett, HTML and CSS: Design and Build Websites, 1st ed. Indianapolis, IN, USA: Wiley, 2011.
5. S. Bhaumik, Bootstrap Essentials, Birmingham, UK: Packt Publishing, 2015.
6. Laboratory Manuals.

Reference Books

1. E. Robson and E. Freeman, Head First HTML and CSS, O'Reilly Media, 2nd ed., 2012.
2. L. Welling and L. Thomson, PHP and MySQL Web Development, Addison-Wesley, 5th ed., 2016.

Online Learning Materials

1. W3Schools, Web Development Tutorials – HTML, CSS, JavaScript, PHP, MySQL, [Online]. Available: https://www.w3schools.com/ Accessed on May 16, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Web Based Technologies and Multimedia Applications	Prof. P.V. Suresh	Indira Gandhi National Open University, New Delhi	https://onlinecourses.swayam2.ac.in/nou25_cs03/preview
2	Web Technology	Dr. Ashutosh Kumar Bhatt	Uttarakhand Open University, Haldwani	https://onlinecourses.swayam2.ac.in/nou24_cs09/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: CIT107
Course Title: Object Oriented Programming with JAVA

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 4	**Credits:** 5
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L) + 60(P) = 105 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 50%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): ESC103

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Recognize the principles and practices of object-oriented programming in constructing robust, maintainable programs.
2	Apply programming logic and syntax to design and implement solutions for computational problems.
3	Analyze and evaluate software designs for effectiveness, efficiency and adherence to object-oriented practices.
4	Implement advanced Java features to build robust and efficient applications.
5	Utilize database connectivity and perform data operations efficiently to manage persistent data in Java applications.
6	Develop, design, implement and debug the programs with object oriented programming using Java.

Contents

Part-A

Unit-1 Introduction to Java **4(L) hrs**

History and Evolution, Byte Code, Buzzwords, Object Oriented Programming-Two Paradigms, Abstraction, Principles of Object-Oriented Programming, Structure of Java Program, Java Typical Environment.

Unit-2 Data Types, Operators and Control Statements **7(L) hrs**

Data Types, Literals, Variables, Type Casting, Arrays, Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, The Conditional Operator, Operator Precedence, Selection Statements, Control Statements, Recursion V/S Iteration.

Unit-3 Classes, Objects and Methods **7(L) hrs**

Classes and Objects, Assigning Object Reference Variable, Methods, Constructors, Overloading Methods, Objects as Parameters, Returning Objects, Overloading Constructors, 'This' Keyword, Garbage Collection, Finalize() Method, Access Specifiers, Static, Final, Command Line Arguments.

Unit-4 Inheritance **5(L) hrs**

Inheritance Basics, Using Super, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Using Final with Inheritance, Constructor in a Derived Class, Object Class.

Part-B

Unit-5 Packages and Interfaces **4(L) hrs**

Packages, Package Access Protection, Importing Packages, Defining an interface, Implementing interfaces, Nested Interfaces, Extending Interfaces, Default Interface Methods.

Unit-6 Exception Handling **5(L) hrs**

Exception Handling Model, Exception Types, Uncaught Exceptions, Try and Catch, Multiple Catch Clauses, Nested Try, Throw, Finally, Built-In Exceptions, Creating Your Own Exception, Chained Exceptions.

Unit-7 Multithreaded Programming **5(L) hrs**

Life Cycle Of Thread, The Main Thread, Creating Thread, Creating Multiple Threads, Using Isalive() And Join(), Thread Priorities, Thread Synchronization, Inter Thread Communications, Suspending, Resuming & Stopping Threads.

Unit-8 String Handling **3(L) hrs**

The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching String, Modifying String, Data Conversion, Changing the Case of Characters, StringBuffer.

Unit-9 Java Database Connectivity **5(L) hrs**

Architecture of JDBC, Types of drivers (Type 1 to Type 4), DriverManager, Connection, Statement, PreparedStatement, CallableStatement, and ResultSet, establishment of connection, CRUD Operations.

Laboratory Work

Experiment No.	Experiment Title
1	Set up the Java Development Kit (JDK) and use an IDE to create and manage a Java project
2	Write, compile, and execute structure of basic Java program in typical java environment.
3	Implement various data types and literals in Java by creating and manipulating variables.
4	Perform arithmetic, relational, bitwise, and logical operations in a program.
5	Perform type casting and operator precedence using a Java program
6	Write a program to implement if, else-if, and switch statements for basic decision-making scenarios.
7	Create loops (for, while, and do-while) to generate patterns or solve simple problems like summing a series of numbers.
8	Compare recursion and iteration by calculating the factorial of a number using both approaches.
9	Implement class with attributes and methods, and create objects to demonstrate object-oriented programming concepts.
10	Write a program to implement constructors (default and parameterized) and method overloading

11	Use this keyword to demonstrate its functionality in constructors and methods.
12	Implement garbage collection and the finalize method by simulating object lifecycle management.
13	Write a program using access specifiers (public, private, protected, default) and demonstrate their scope.
14	Create static methods and variables and show their usage with examples.
15	Write a program to accept command-line arguments and use them to perform basic arithmetic operations.
16	Create a base class and a derived class to demonstrate inheritance and method overriding.
17	Use the super keyword to access members of a parent class
18	Create abstract classes by creating and implementing an abstract class hierarchy
19	Use the final keyword with variables, methods, and classes and observe the behavior.
20	Implement a program that uses a package and imports another package to demonstrate modular programming.
21	Create and implement interfaces and demonstrate interface inheritance and default methods
22	Write a program to handle exceptions using try, catch, and finally blocks
23	Implement nested try statements and create custom exceptions in Java.
24	Create multiple threads and implement thread synchronization in a program.
25	Use thread methods such as isAlive() and join() in a multithreaded program.
26	Write a program to suspend, resume, and stop threads using appropriate methods.
27	Implement string manipulation techniques i.e. length, comparison, searching, and modifying strings.
28	Create and manipulate StringBuffer and demonstrate its use in a Java program.
29	Establish a database connection using JDBC and perform CRUD operations.

Mini Project: By using various concepts of Java, students are required to prepare a project in a group of two to three students. The usage of concepts like applets, multithreading and JDBC for project is to be encouraged. The group of students must submit a project report of 8 to 10 pages (approximately) and the team will have to demonstrate the project as well as have to give a presentation on the same. Note: It is recommended that mini project allocation to students be done within two-three weeks of the start of the semester. This is only the suggested list of Practical's. Instructor may also frame additional Practical's relevant to the course contents (if required)

Text Books

1. Herbert Schildt, "Java: The Complete Reference, 13th Edition", 2024.
2. Paul Deitel, Harvey Deitel "Java How To Program", Prentice Hall, 2011.
3. Laboratory Manuals.

Reference Books

1. Balagurusamy, "Programming in Java" Tata McGraw- Hill, 2009.

Online Learning Materials

1. https://www.geeksforgeeks.org/object-oriented-programming-oops-concept-in-java/ Accessed on May 16, 2025
2. https://www.w3schools.com/java/java_oop.asp Accessed on May 16, 2025

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Programming in Java	Prof. Debasis Samanta	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_cs57/preview

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: CIT108
Course Title: Advanced and Emerging Trends in IT

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:**4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P)= 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course (Integrated)		

Prerequisites (if any): BSIT101, CIT102, ESC103, ESC105

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Apply fundamental AI and ML principles to develop intelligent, data-driven solutions using suitable algorithms and tools.
2	Analyse and interpret complex datasets through preprocessing, modelling, and visualization to enable data-driven decision-making.
3	Demonstrate practical skills in reconnaissance, information gathering, and vulnerability analysis using tools like NMAP, Wireshark, and Burp Suite.
4	Describe the architecture and components of modern full-stack web and mobile application development environments (e.g., MEAN, MERN, Flutter).
5	Assess emerging trends like Web3, DAOs, Layer-2 solutions, and decentralized AI in terms of scalability and ethical implications.
6	Design and develop basic web applications integrating front-end and back-end frameworks with APIs.

Contents

Part-A

Unit-1 Introduction to Artificial Intelligence **6(L) hrs**

Definition and scope of Artificial Intelligence, history and evolution of AI, applications and branches of AI (expert systems, NLP, vision, robotics), types of intelligent agents and environments, problem-solving approaches, uninformed and informed search strategies, and ethical and societal aspects of AI. Representation of knowledge, propositional and predicate logic, inference rules, knowledge-based systems, reasoning under uncertainty, introduction to Bayesian networks and fuzzy logic.

Unit-2 Machine Learning Fundamentals **8(L) hrs**

Learning types – supervised, unsupervised, reinforcement; ML workflow; importance of data preprocessing and feature extraction, Basic Learning Models: Conceptual understanding of Linear Regression and Decision Trees; evaluating model performance using simple metrics. Unsupervised Learning Concepts: Introduction to clustering and pattern discovery; basics of K-Means and data grouping intuition. Neural Networks: Perceptron model, idea of learning weights, activation functions, and real-world use cases; Introduction to Python-based AI tools (Scikit-learn, TensorFlow basics); hands-on demonstration through sample datasets.

Unit-3 Data Science and Big Data Analytics **9(L) hrs**

Data Science: Definition, lifecycle, and significance; data-driven decision-making, key applications across industries. Data Collection and Preprocessing: Types and sources of data; techniques for cleaning, handling missing values, normalization, and encoding. Exploratory Data Analysis (EDA): Descriptive statistics, visualizing data patterns using histograms, box plots, and correlation analysis. Big Data Concepts: Characteristics of Big Data (Volume, Velocity, Variety & Veracity), challenges in storage and processing. Python for Data Science: Overview of Python libraries – Pandas, NumPy, Matplotlib; demonstration of simple data manipulation and visualization. Big Data Ecosystem Overview: Conceptual introduction to Hadoop, HDFS, and Spark; relevance of distributed systems.

Part-B

Unit-4 Network Security and Ethical Hacking 6 (L) hrs

Network security, Model for Network security, Model for Network access security, Real-time Communication Security, Introduction to ethical hacking, Installation of attacker and victim system. Information gathering using advanced Google search, archive.org, netcraft, whois, host, dig, dnsenum, and NMAP tool, Packet sniffing using Wireshark and Burp Suite, password attack using Burp Suite. Social engineering attacks and denial-of-service attacks.

Unit-5 Full Stack Web and Mobile Application Development 8 (L) hrs

Introduction to Full Stack Development (Popular Stacks – MEAN, MERN), Web Development Fundamentals, Front-End Frameworks Overview, Overview Back-End and API Concepts, Mobile Application Development: Introduction to Flutter and Android Studio; Basics; Flutter / Android Studio Project Structure; Widgets and UI Design Concepts

Unit-6 Blockchain and Decentralized Technologies 8 (L) hrs

Evolution of Blockchain Technology: From Bitcoin to Web3, Centralized vs. Decentralized Systems, Structure of a Blockchain: Blocks, Hashes, and Chains, Types of Blockchain: Public, Private, Consortium, and Hybrid, Applications and Future of Decentralization, Blockchain in Finance (DeFi, NFTs, CBDCs), Supply Chain and Logistics, Healthcare and Data Sharing, E-Governance and Identity Management, Future Trends: Layer-2 Solutions, DAOs, Web3, and Decentralized AI.

Practical hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Laboratory Work

Practical 1: Data Handling and Preprocessing using Python
To learn how to import, explore, clean, and prepare real-world data for analysis or machine learning.

- Load a dataset
- Display summary statistics and identify missing values.
- Handle missing/outlier values and normalize or encode data.

Practical 2: Exploratory Data Analysis and Visualization
To perform basic statistical analysis and visualize data patterns for insights.

- Compute mean, median, variance, and correlation between features.
- Plot histograms, bar charts, and scatter plots to understand relationships.
- Interpret trends or clusters visually.

Practical 3: Implementation of a Simple Machine Learning Model
To understand and implement the workflow of a basic supervised learning algorithm.

- Split a small dataset into training and testing sets.
- Implement a Linear Regression (for prediction) or Decision Tree (for classification).
- Evaluate performance using accuracy, MAE, or confusion matrix.

Practical 4: Perform Network Sniffing using wire shark tool.

Practical 5: Create a social networking website login page using the phishing techniques

Practical 6: Design and Development of basic MERN/MEAN Demo App (Node + Express "Hello World")

Practical 7: Design and Development of basic Android Studio / Flutter Demo App ("Hello World" on Emulator)

Practical 8: Exploring Blockchain Structure Using Python
To understand how blocks, hashes, and linking work in a blockchain.

- Create a simple Python class Block with attributes like index, timestamp, data, previous_hash.
- Generate the block's hash using hashlib.sha256().
- Append blocks to a list (blockchain).
- Display the chain and observe how changing one block breaks the chain.

Practical 9: Simulating a Cryptocurrency Transaction Using MetaMask and a Testnet
To experience real blockchain transactions and wallet interactions.

- Install MetaMask and connect to an Ethereum test network.
- Obtain test ETH from a faucet.
- Deploy a simple Solidity contract on Remix (like a token or payment contract).
- Interact with the contract — send, receive, and view transactions on Etherscan.

Practical 10: Blockchain Use Case Demo – Product Tracking in Supply Chain
To simulate how blockchain ensures transparency in product movement.

- Write a Solidity smart contract to record product ID, source, destination, and timestamps.
- Deploy on testnet or local Ganache blockchain.
- Add entries for each stage of supply chain (manufacturer → distributor → retailer).
- Retrieve and verify records to show tamper-proof tracking.

Textbooks

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020.
2. Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Artificial Intelligence, 3rd Edition, McGraw Hill Education, 2019.
3. Seema Acharya and Subhashini Chellappan, Big Data and Analytics, 2nd Edition, Wiley India Publishers, 2019.
4. Rajkamal and Preeti Saxena, Big Data Analytics: Introduction to Hadoop, Spark and Machine Learning, McGraw Hill Education, 2021.
5. Foster Provost and Tom Fawcett "Data Science for Business", O'Reilly Media, Inc., 2014
6. Sinan Ozdemir, Sunil Kakade, "Principles of Data Science - Second Edition", Packt Publishing, 2018.

7. Jake Vanderplas "Python Data Science Handbook: Essential Tools for Working with Data,", O'Reilly; Second Edition (Grayscale Indian Edition),. 2022
8. Kennedy Behrman "Foundational Python for Data Science", Pearson Addison-Wesley, 2023.
9. Drescher, D., Blockchain basics: A non-technical introduction in 25 steps. Apress, 2017
10. Bashir, I. Mastering blockchain: Unlocking the world of cryptocurrencies, smart contracts, and decentralized applications (3rd ed.), Packt Publishing, 2020.
11. Modi, R. . Blockchain technology: Principles and applications. BPB Publications,2021.
12. Chandra, P., & Singh, R. Blockchain and cryptocurrency: The technology, economics, and regulation. McGraw Hill, 2022.
13. Hadnagy, C. Social engineering: The science of human hacking (2nd ed.). Wiley, 2018.
14. Stallings, W. Network security essentials: Applications and standards (6th ed.), Pearson, 2017.
15. Perrone, M. Learning full-stack JavaScript development: MEAN and MERN stack. BPB Publications, 2020.
16. Scheele, D. Full stack development with React and Node.js: Build scalable, full-stack web applications using modern tools and techniques. Packt Publishing, 2021.
17. Somasundaram, A. Beginning Flutter: A hands-on guide to app development. Apress, 2021.

Reference Books

1. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media, 2019.
3. Adam Shook and Donald Miner, MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems, O'Reilly Media, 2012.
4. Tom White, Hadoop: The Definitive Guide, 4th Edition, O'Reilly Media, 2015.
5. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, 1st Edition, Pearson India Education Services Pvt. Ltd., 2016
6. Antonopoulos, A. M. Mastering Bitcoin: Programming the open blockchain (2nd ed.). O'Reilly Media, 2017.
7. Mardan, A. Full stack JavaScript: Learn backbone.js, node.js, and MongoDB. O'Reilly Media, 2018
8. Lerner, A. (2019). Learning React: Modern patterns for developing React apps (2nd ed.). O'Reilly Media, 2019.
9. Dayley, B., & Dayley, B. (2018). Node.js, MongoDB, and Angular web development (2nd ed.). Addison-Wesley, 2018.
10. Jain, S. (2021). Flutter for beginners: A step-by-step guide to building cross-platform mobile applications. Packt Publishing, 2021.

Guru Nanak Dev Engineering College, Ludhiana

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B.Tech. 2nd Year (Information Technology)

Course Code: CIT109
Course Title: Discrete Mathematics

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0	**Credits:**4
Semester: 4	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)= 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 60%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): BSC102, BSC104

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	To develop logical thinking and its application to computer science.
2	To reason mathematically about basic data types and structures used in computer algorithms and systems.
3	To exhibit the understanding of counting principles, permutations, combinations, and recurrence relations to solve combinatorial problems.
4	To illustrate the basic properties and algorithms of graphs and apply them in modeling and solving real-world problems.
5	To analyze and differentiate various algebraic structures for engineering problems.
6	To demonstrate the use of discrete structures in solving interdisciplinary problems.

Contents

Part-A

UNIT 1- Fundamentals of Sets, Relations and Functions **10(L) hrs**

Sets – Operations on sets, Subsets, Types of sets, Ordered pairs, Proofs of general identities of sets, Classes of sets and partitions, Countable and uncountable sets, Inclusion and exclusion principle. Relations – Properties of relations, Types of relations, Composition of relations, closure properties of relations, Equivalence relations, Compatibility relations, Partial order relations. Functions – Introduction and types of functions, Sum and product of functions, Hashing functions, Recursively defined functions.

Unit-2 Prepositional and Predicate Logic **3(L) hrs**

Propositional logic, Truth tables, Normal forms (conjunctive and disjunctive), Validity of well-formed formula, Propositional inference rules, Predicate logic, Universal and existential quantifiers.

Unit-3 Combinatorial Mathematics **10(L) hrs**

Basic counting principles, Permutations and combinations, Pigeonhole principle, Recurrence relations – Solving homogeneous and non-homogeneous recurrence relations, Generating function.

Part-B

Unit-4 Graph Theory **12(L) hrs**

Graphs- Graph terminology, Directed and undirected graphs, Bi-connected component and Articulation points, Eulerian chains and cycles, Planar graphs, Euler's Theorem for Planar Graphs, Isomorphic and homomorphic graphs, Hamiltonian path, trees, Tree traversals, Spanning trees, Representation of relations by graphs, Applications of Graph theory.

Unit-5 Algebraic Structures **10(L) hrs**

Group, Semi group, Monoids, Homomorphism, Congruencies, Field, Cyclic groups, Cosets, Normal subgroups, Dihedral groups, Permutation Groups, Ring: Introduction, Abelian ring, Ring with unity, Multiplicative inverse, Subrings, Homomorphism of rings, Applications of algebraic structure

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1. Lipschutz and M.Lipson, "Schaum's Outline of Discrete Mathematics", 4th edition, Tata McGraw Hill (2022).
2. K.H. Rosen, "Discrete Mathematics and its applications", 8th edition, Tata McGraw Hill (2021).
3. Tremblay, J.P. and Manohar R., "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill (2008), 1st ed.

Reference Books

1. A. Doerr and K. Levarseur, "Applied Discrete Structures for Computer Science", 3rd edition, Pearson Education, Inc. (2018).
2. C.L. Liu , " Elements of Discrete Mathematics" , Tata McGraw Hill, 2008.

Online Learning Materials

1. Discrete Maths by Anil S. Khairnar: https://www.researchgate.net/publication/309039733_Discrete_Mathematics_Textbook Accessed on May 14, 2025
2. Discrete Mathematical Structures by Bernard Kolman, Robert C. Busby, Sharon Cutler Ross
3. https://www.dbscience.org/wp-content/uploads/2020/03/Discrete_Mathematical_Structures-Kolman.pdf Accessed on May 14, 2025
4. https://www.youtube.com/watch?v=p2b2Vb-cYCs&list=PLBlnK6fEyqRhqJPDXcvYlLfXPh37L89g3 Accessed on May 14, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Discrete Mathematics	Prof. Sudarshan Iyengar	IIT Ropar	https://onlinecourses.nptel.ac.in/noc20_cs37/preview
2	Discrete Mathematics	Prof. Minirani S	NMIMS Deemed University	https://onlinecourses.swayam2.ac.in/cec20_ma02/preview