SCHEME OF INSTRUCTIONS AND SYLLABUS

B.Tech. in Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Regulation: SU24

w.e.f. 2024-25

Departement of Computer Science and Engineering

Velagapudi Ramakrishna
Siddhartha School of Engineering
SIDDHARTHA ACADEMY OF HIGHER EDUCATION
(An Institution Deemed to be University)
Under section 3 of UGC Act 1956
Sponsered by Siddhartha Academy of General & Technical Education

INSTITUTION VISION

To be a Centre of Excellence in Education, Innovation and Research with Global presence in Arts, Science, Technology, Medicine, Management, Legal and Social Studies in enriching the frontier areas of National and International Importance.

INSTITUTION MISSION

- To create a transformative educational experience for students focused on problem solving skills; communication abilities, and interpersonal relations and leadership.
- To cultivate a vibrant university community for attracting and retaining diverse, world-class talent creating a collaborative environment open to the free exchange of ideas where research, creativity, innovation and entrepreneurship can flourish and ensuring individuals to achieve their full potential
- To impact society in a pragmatic manner— regionally, nationally, and globally — by engaging with industry, outstanding national and international universities and research organizations
- To be a global University that nurtures excellence in education and innovation for creating a knowledgeable society

DEPARTMENT VISION

To emerge as a global center of excellence in Computer Science and Engineering by imparting quality education, fostering innovation, and cutting-edge technologies, thereby addressing national priorities and contributing to technological and societal advancements.

DEPARTMENT MISSION

- To lay a strong foundation in Computer Science and Engineering by cultivating analytical thinking, algorithmic problem-solving, programming proficiency, teamwork, and leadership skills to the students.
- To build a vibrant academic and research ecosystem that attracts talent and fosters collaboration in frontier areas.
- To strengthen industry and global research partnerships to drive innovations in computing, foster entrepreneurship, and deliver solutions to real-world challenges.
- To advance computing knowledge and innovation through impactful research and education, contributing to a digitally empowered, knowledge-driven society

PROGRAM EDUCATIONAL OBJECTIVES (UG)

We have program educational objectives for our Computer Science and Engineering Program. Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Our program objectives are:

- The graduates of the Program will have solid foundation in the principles and practices of computer science, including mathematics, science and basic engineering.
- The graduates of the Program will have skills to function as members of multi-disciplinary teams and to communicate effectively using modern tools.
- The graduates of the Program will be prepared for their careers in the software industry or pursue higher studies and continue to develop their professional knowledge.
- The graduates of the program will practice the profession with ethics, integrity, leadership and social responsibility.

PROGRAM OUTCOMES

On successful completion of the B.Tech CSE (AI&ML) Programme the student will be able to :

- **PO1: Engineering knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop solutions for complex engineering problems.
- **PO2: Problem analysis:** Identify, formulate, review research literature and analyze complex engineering problems, reaching substantiated conclusions with consideration for sustainable development (WK1 to WK4).
- PO3: Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems, components, or processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society, and environment as required. (WK5)
- **PO4: Conduct investigations of complex problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis, and interpretation of data to provide valid conclusions. (WK8)
- **PO5: Engineering Tool Usage:**Create, select, and apply appropriate techniques, resources, and modern engineering & IT tools, including prediction and modelling, recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- **PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for their impact on sustainability with reference to economy, health, safety, legal framework, culture, and environment. (WK1, WK5, and WK7)
- **PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; adhere to national & international laws. (WK9)
- **PO8: Individual and Collaborative Team Work** : Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- **PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, and make effective presentations considering cultural, language, and learning differences.
- **PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects in multidisciplinary environments.
- **PO11:Life-Long Learning:** : Recognize the need for, and have the preparation and ability for:
  - Independent and life-long learning,
  - Adaptability to new and emerging technologies
  - Critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES

- **PSO1:** Apply computer science and machine learning principles to develop intelligent algorithms and predictive models for solving complex problems in vision, language, and decision-making.
- **PSO2:** Use AI/ML tools to analyze large-scale data and deliver innovative, ethical solutions for real-world applications.

SIDDHARTHA ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
Velagapudi Ramakrishna
Siddhartha School of Engineering
SU24 Regulations
Department of Computer Science and Engineering
B.Tech. Computer Science and Engineering
(Artificial Intelligence and Machine Learning)
Curriculum for Semesters I to VIII

The B.Tech – CSE (AI & ML) program is designed to provide students with a strong foundation in both Computer Science and cutting-edge technologies such as **Artificial Intelligence (AI)** and **Machine Learning (ML)**. The department aims to produce graduates equipped with the skills needed to excel in AI and ML-driven industries. The curriculum integrates core subjects of computer science with specialized courses in AI and ML, enabling students to develop expertise in areas like **data science, neural networks, natural language processing, and computer vision**. The department fosters a collaborative learning environment, offering hands-on experiences through research projects, industry internships, and partnerships with leading technology companies. Students in this program have access to state-of-the-art labs, faculty with expertise in AI/ML, and opportunities for interdisciplinary learning. The department strives to nurture innovative thinkers who can contribute to the rapidly evolving world of AI and ML.

SEMESTER-I **CONTACT HOURS:28**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA101	BS	Mathematics-I (Linear Algebra, Series, and Calculus)	3	0	2	4
2	24PH101	BS	Applied Physics	3	0	0	3
3	24EN101	HS	Communicative English	3	0	3	4.5
4	24CS102	ES	Programming using C	3	0	0	3
6	24CS181	ES	Programming using C Lab	0	0	3	1.5
5	24UC101	ES	Design Thinking	0	0	2	1
6	24PH181	BS	Physics Lab	0	0	2	1
7	24UC182	ES	AI Tools and Applications	0	0	2	1
8	24UC101	MC	Essence of Indian Knowledge Tradition	2	0	0	0
Total				**14**	**0**	**14**	**19**

SEMESTER-II **CONTACT HOURS:31**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA102	BS	Mathematics-II (Differential eqs. & Numerical methods)	3	0	2	4
2	24CY101	BS	Applied Chemistry	3	0	0	3
5	24BY101	BS	Biology for Engineers	3	0	0	3
4	24IT102	ES	Data Structures	2	0	2	3
3	24IT101	ES	Problem Solving with Python	2	0	2	3
6	24ME181	ES	Engineering Graphics	1	0	3	2.5
7	24CY181	BS	Chemistry Lab	0	0	2	1
8	24ME182	ES	Workshop Practice	0	0	3	1.5
7	24UC183	MC	Sports & Yoga or NSS or NCC	0	0	3	0
Total				**14**	**0**	**17**	**21**

SEMESTER-III **CONTACT HOURS:27**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA203	BS	Probability and Statistics	4	0	0	4
2	24CS201	ES	Digital Logic and Design	3	0	0	3
3	24CS202	PC	Object Oriented Programming Through Java	3	0	0	3
4	24CS203	PC	Software Engineering	3	0	0	3
5	24CS204	PC	Operating Systems	3	0	2	4
6	24CS281	PC	Object Oriented Programming Through Java Lab	0	0	3	1.5
7	24CS282	ES	Digital Logic and Design Lab	0	0	3	1.5
8	24UC201	MC	Universal Human Values - II	2	1	0	3
Total				**18**	**1**	**8**	**23**

SEMESTER-IV **CONTACT HOURS:29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA204	BS	Discrete Mathematics	3	0	0	3
2	24CS205	PC	Database Management Systems	3	0	0	3
3	24CS206	PC	Computer Networks	3	0	0	3
4	24CS207	PC	Computer Organization & Architecture	3	1	0	4
5	24CS209	PC	Artificial Intelligence	3	0	2	4
6	24CS283	PC	Database Management Systems Lab	0	0	3	1.5
7	24CS284	PC	Computer Networks Lab	0	0	3	1.5
8	24EN281	HS	English for Professionals	0	0	2	1
9	24UC202	MC	Professional Ethics	2	0	0	0
Total				**17**	**1**	**12**	**21**
Minor/Honours Courses (Optional)				3	0	0	3

- **Engineering Project in Community Services (EPICS)**: The Engineering Project for community services will be carried out during summer vacation for a period of six weeks after the IV Semester and the report shall be submitted in the V Semester. Students will go to the society (Villages/ Hospitals/Towns, etc..) to identify the problem, survey the literature and discuss with the community for a feasible solution. The students are encouraged to solve real-life problems.
- **Mini Project:** The Mini Project is carried out during the VII semester. Students have to carry out feasibility studies, and literature surveys, and prepare a detailed project report.
- **Major Project:** The Major Project is carried out in the VIII semester and the student can carry out his/her project work in an industry/R&D organization/in the college with well-defined objectives. At the end of the semester, the student shall submit a detailed project report. It involves the preparation and presentation of a report and students are encouraged to publish their work in any research journal/conference. The project report shall be evaluated by a committee appointed by HoD.

SEMESTER-V **CONTACT HOURS : 32**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24CS301	PC	Machine Learning	3	1	0	4
2	24CS302	PC	Design and Analysis of Algorithms	3	0	0	3
3	24CS303	PC	Theory of Computation	3	0	0	3
4	24CS360A	IE	Inter disciplinary Elective I	3	0	0	3
5	24CS310A 24CS310H 24CS310J 24CS310D 24CS310E 24CS310F	PE-I	A. Soft Computing B. Optimization Techniques C. Cognitive Science D. Augmented and Virtual Reality E. UI & UX Design F. Full Stack Development-I	3	0	0	3
6	24CS303	PL	Machine Intelligence Lab	0	0	3	1.5
7	24CS385	PL	Design and Analysis of Algorithms Lab	0	0	3	1.5
8	24CS381	PR	EPICS	0	0	4	2
9	24EN381	HS	Advanced communication skills	0	0	2	1
10	24CS382	PC	Industry Standard Coding Practice - I	0	0	2	1
11	24UC301	MC	Constitution of India	2	0	0	0
Total				**17**	**1**	**14**	**23**
Minor/Honours Courses (Optional)				3	0	0	3
Minor/Honours Courses (Optional)				2	0	0	2

SEMESTER-VI **CONTACT HOURS:27**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24CS304	PC	Deep Learning	3	1	0	4
2	24CS307	PC	Natural Language Processing	3	1	0	4
3	24CS370A	IE	Inter disciplinary Elective–II	3	0	0	3
4	24CS320G 24CS320H 24CS320I 24CS320J 24CS305 24CS320F	PE-II	A. Knowledge Engineering B. Game Theory C. Bioinformatics D. Digital Image Processing E. Cryptography & Network Security F. Full Stack Development-II	3	0	0	3
5	24CS330G 24CS330H 24CS330I 24CS330D 24CS330E 24CS330F	PE-III	A. Reinforcement Learning B. Probabilistic Graphical Models C. MLOps D. Generative AI E. Cyber Forensics F. Mobile Application Development	3	0	0	3
6	24CS388	PL	Deep Learning Lab	0	0	3	1.5
7	24CS390	PL	Natural Language Processing Lab	0	0	3	1.5
8	24CS383	PC	Industry Standard Coding Practice-II	0	0	2	1
9	24UC302	MC	Environmental Science	2	0	0	0
Total				**17**	**2**	**8**	**21**
Minor/Honours Courses (Optional)				3	0	0	3
Minor/Honours Courses (Optional)				2	0	0	2

SEMESTER-VII **CONTACT HOURS:23**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24CS401	PC	Compiler Design	3	1	0	4
2	24OE410A	OE	Open Elective– I	3	0	0	3
3	24CS440B 24CS440G 24CS440H 24CS440I 24CS440E 24CS440F	PE-IV	A. Generative AI B. Graph Neural Networks C. Federated Learning D. Image and Video Analytics E. Cyber Security F. Full Stack Development-III	3	0	0	3
4	24CS410A	HE	Humanities Elective – I	3	0	0	3
5	24CS481	PR	Summer Internship	0	0	4	2
6	24CS482	PC	Advanced Skill Course	0	0	2	1
7	24CS483	PR	Mini Project	0	0	4	2
Total				**12**	**1**	**10**	**18**
Minor/Honours Courses (Optional)				3	0	0	3
Minor/Honours Courses (Optional)				2	0	0	2

SEMESTER-VIII **CONTACT HOURS:22**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24HE420A	HE	Humanities Elective -II	3	0	0	3
2	24OE420A	OE	Open Elective– II	3	0	0	3
3	24CS484	PR	Major Project	0	0	16	8
Total				**6**	**0**	**16**	**14**
Minor/Honours Courses (Optional)				2	0	0	2

Humanities Elective Courses (HE Basket)
Project Management
Engineering Economics & Mgmt.
Innovation, IPR & Enterpreneurship
Operations Research
Industrial Psychology
Finance and Accounting
Organizational Behavior
+
Any management course offered by SAHE/Online (Swayam/NPTEL) and approved by department

Open Elective Courses (OE Basket)
Foreign Language
Music
Law
+
Any course offered by SAHE/Online (Swayam/NPTEL) and approved by department

HONOR DEGREE IN QUANTUM COMPUTING

S.No	Course Code	Semester	Course Name	L	T	P	Credits
1	24OE520A	IV	Introduction to Quantum Computing	4	0	0	4
2	24OE520B	V	Superconducting Qubit Quantum Processors	4	0	0	4
3	24OE520C	VI	Design and Analysis of Quantum Algorithms	3	0	2	4
4	24OE520D	VII	Quantum Machine Learning & AI	3	0	2	4
5	24OE520E	VIII	Quantum Communication & Cryptography	4	0	0	4
Total				**18**	**0**	**4**	**20**

HONOR DEGREE IN CLOUD ENGINEERING

S.No	Course Code	Semester	Course Name	L	T	P	Credits
1	24OE521A	IV	Cloud Computing Foundation	3	0	2	4
2	24OE521B	V	Cloud Engineering	3	0	2	4
3	24OE521C	VI	Cloud Data Analytics - I / Cloud Cyber Security– I	3	0	2	4
4	24OE521D	VII	Cloud Data Analytics – II / Cloud Cyber Security– II	3	0	2	4
5	24OE521E	VIII	Generative AI	3	0	2	4
Total				**15**	**0**	**10**	**20**

COURSE CODE: 24MA203
PROBABILITY AND STATISTICS

Course Category:	Basic Sciences (BS)	**Credits:**	4
Course Type:	Theory	**Lecture -Tutorial-Practice:**	4-0-0
Pre-requisites:	Linear Algebra, Series, and Calculus	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course provides a comprehensive understanding of probability and statistics, focusing on theoretical foundations and practical applications. Students will explore fundamental concepts such as probability distributions, statistical inference, hypothesis testing, and data analysis techniques. Key topics include discrete and continuous probability distributions (Binomial, Poisson, Normal), joint distributions, and the Central Limit Theorem. Emphasizing real-world applications, students will develop problem-solving skills to analyze data, model uncertainties, and make informed decisions based on statistical reasoning.

Course Objectives

- To develop a strong foundation in probability theory, including discrete, continuous, and joint distributions.
- To learn to construct confidence intervals, perform hypothesis testing, and make data-driven inferences.
- To gain proficiency in statistical estimation, variance analysis, and data interpretation techniques.
- To apply probability and statistical models to real-world problems in machine learning, finance, and research.
- To use computational tools to implement probability and statistical techniques for data analysis and decision-making.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Explain probability distributions, joint distributions, and the Central Limit Theorem.	**K2**	1.2.1, 1.2.2, 2.6.3, 4.6.1
CO2	Interpret confidence intervals and hypothesis testing for statistical inference.	**K2**	1.2.1, 1.2.2, 2.6.3, 4.6.1
CO3	Apply probability and statistical methods to real-world problems.	**K3**	1.2.2, 2.6.3, 4.6.1, 4.6.3
CO4	Analyze datasets to estimate parameters and test hypotheses.	**K3**	2.5.2, 2.6.3,3.5.1
CO5	Evaluate probabilistic models using computational tools for decision-making.	**K4**	1.2.1, 2.6.3, 4.6.1, 4.6.3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3		2										
CO2	3	3		2									1	
CO3	3	3		2									1	
CO4	3	3		2									1	
CO5	3	3		2									1	

Course Content

Unit – I :Probability Distributions and Random Variables

Probability Distributions: Random Variables, Binomial distribution, Hypergeometric Distribution, Poisson approximation to the Binomial distribution, Poisson process.

Unit – II: Probability Densities and Joint Distributions

Probability Densities: Continuous random variables, Normal distribution, Normal approximation to the Binomial distribution.
Joint distribution: Joint Distributions-Discrete and Continuous.

Unit – III: Statistical Inference

Inferences Concerning a Mean: Point Estimation- Interval Estimation, Tests of Hypotheses, Null Hypotheses and Tests of Hypotheses, Hypotheses concerning one mean, Relation between tests and confidence intervals, Comparisons-Two independent large samples, Comparisons-Two independent small samples.

Unit – IV :Variances and Proportions

Inferences Concerning Variances: Estimation of variances, Hypotheses concerning one variance, Hypotheses concerning two variances.
Inferences Concerning Proportions: Estimation of Proportions, Hypotheses concerning one Proportion, Hypotheses concerning several Proportions, The analysis of r x c tables.

Unit – V: Non-Parametric Statistical Tests

Non parametric Tests: Introduction, The Sign Test, Rank-Sum tests, Correlation based on ranks, Tests of Randomness.

Text Books

1. R. A. Johnson, Probability and Statistics for Engineers, 8th Edition, Prentice Hall India Learning Private Limited, 2011.

Reference Books

1. R. E. Walpole, R. H. Myers, S. L. Myers, and K. Ye, Probability and Statistics for Engineers and Scientists, 5th Edition, Macmillan, New York, 1993.
2. P. C. Biswal, Probability and Statistics, Prentice Hall India Learning Private Limited, 2007.
3. T. K. V. Iyengar, B. K. Gandhi, S. Ranganadham, and M. V. S. S. N. Prasad, Probability and Statistics, S. Chand Publishing, 2008.

Web Resources

1. **NPTE**L, ""Probability and Statistics," Prof. Somesh Kumar, Department of Mathematics, IIT Kharagpur, [Online]. Available: `https://nptel.ac.in/courses/111105090`. [Accessed: Mar. 7, 2025].
2. **NPTEL**, "Probability and Statistics," Prof. Niladri Chatterjee, Department of Mathematics, IIT Delhi, [Online]. Available: `https://nptel.ac.in/courses/111102112`. [Accessed: Mar. 7, 2025].
3. **NPTEL**, "Probability and Statistics," Prof. Soumen Maity, Department of Mathematics, IISER Pune, [Online]. Available: `https://nptel.ac.in/courses/111105042`. [Accessed: Mar. 7, 2025].

COURSE CODE: 24CS201
DIGITAL LOGIC DESIGN

Course Category:	Engineering Sciences (ES)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-0
Pre-requisites:	—	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

Digital Logic Design provides an in-depth introduction to the principles and techniques used in the design and analysis of digital systems. Students will explore the fundamentals of digital logic, the building blocks of modern computing systems, and their applications in hardware design. The course emphasizes both combinational and sequential logic circuits, digital number systems, Boolean algebra, analysis, design, and evaluation of digital circuits, of medium complexity, that are based on SSIs, MSIs, and programmable logic devices. The main objectives are to provide knowledge on methods for simplifying Boolean functions and to develop skills for design of various combinational & sequential logic circuits.

Course Objectives

- To introduce key number systems, Boolean algebra, and logic gate concepts required for digital system design.
- To simplify Boolean functions using various methods and apply them in designing efficient digital systems.
- To design and implementation of combinational and sequential logic circuits.
- To develop an understanding of the structure and operation of programmable logic devices and their applications in system design.
- To design, analyze, and implement memory systems and counters.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand Number systems and Boolean algebra.	**K2**	1.2.1, 1.7.1
CO2	Apply simplification techniques to minimize Boolean functions.	**K3**	1.2.1, 1.7.1, 2.7.2
CO3	Apply combinational logic concepts to design and implement MSI and LSI circuits	**K3**	1.7.1, 2.7.1, 2.7.2, 3.7.1 ,3.8.1
CO4	Apply sequential logic principles to design clocked sequential circuits using flip-flops.	**K3**	1.7.1, 2.7.1, 2.7.2, 3.7.1 ,3.8.1
CO5	Apply sequential logic techniques to design Counters, Registers and Memory elements.	**K3**	1.7.1, 2.7.1, 2.7.2, 3.7.1 ,3.8.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2													
CO2	2	2												
CO3	2	2	2											1
CO4	2	2	2											1
CO5	1	2	2											

Course Content

Unit – I : Number Systems, Boolean Algebra, and Logic Gates

Binary Systems: Digital computers and digital systems, Number systems, conversions Complements: r's complement, (r-1)'s complement, Binary Codes, Representation of integers and Floating-point numbers, Introduction to integer arithmetic operations.
Boolean Algebra and Logic Gates: Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and Properties of Boolean Algebra, Boolean functions, Canonical and Standard Forms, Other logic operations, Digital Logic Gates

Unit – II : Boolean Function Simplification and Combinational Logic Design

Simplification of Boolean Functions: The Map Method, Two and three variable Maps, Four-variable Map, five variable Map, Product of Sums Simplification, Don't care conditions, The Tabulation Method, Determination of Prime Implicants, Selection of Prime-Implicants.
Combinational Logic: Introduction, Design Procedure, Adders, Subtractors, Code Conversion, Analysis Procedure. Exclusive-or Gates, Parity Generators and Checkers.

Unit – III : Combinational Circuits and Programmable Logic Devices

Combinational Logic with MSI and LSI: Binary Parallel Adder, Decimal Adder, Magnitude Comparator, Decoders, demultiplexers, encoders, Multiplexers.
Programmable Logic: Programmable Logic Devices (PLD), Programmable read only memory (PROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL), Introduction to FPGA.

Unit – IV : Sequential Logic and State Machine Design

Sequential Logic: Sequential circuits, Classification, Latches, Flip Flops, Triggering of Flip-Flops, Master slave flip-flop, Flip-Flop Excitation tables, flip-flop direct inputs.
Analysis of Clocked Sequential Circuits: State table, State diagram, state equations, State Reduction and Assignment, Design Procedure, design with unused states, Design of Counters.

Unit – V : Registers, Counters, and Memory Units

Registers, Counters: Registers, Shift Registers, Asynchronous Counters, Synchronous Counters, Ring Counter, Johnson Counter, Timing Sequences.
Memory Units: Block diagram of memory unit, Design of ROM, Classification of ROMs, Design of RAM, Classification of RAMs.

Text Books

1. M.Morris Mano, Digital Logic & Computer Design 1 e/d reprint, Pearson education, 2016.
2. M.Morris Mano, Michael D Ciletti Digital Design with an Introduction toVerilog HDL 5th e/d, Pearson education, 2013

Reference Books

1. A. Anand Kumar, Switching Theory and Logic Design, 2nd Edition, PHI,2013
2. Charles H.Roth , Fundamentals of Logic Design, 6/e, Cengage learning,2010
3. Computer Architecture and Organization Designing for Performance, William Stallings, Ninthedition, Pearson Education series, 2014.

Web Resources

1. **NPTEL**, "Digital Systems," Prof. N. Goel, Department of Electrical Engineering, IIT Ropar, [Online]. Available: `https://nptel.ac.in/courses/108/106/108106177/`. [Accessed: Feb. 25, 2025].
2. **NPTEL**, "Digital Systems," Prof. N. J. Rao, Department of Electrical Engineering, IISc Bangalore, [Online]. Available: `https://nptel.ac.in/courses/106/108/106108099/`. [Accessed: Feb. 25, 2025].

COURSE CODE: 24CS202
OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Course Category:	Program Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-0
Pre-requisites:	Programming using 'C'	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

The course provides a comprehensive introduction to Java programming, focusing on fundamental constructs, object-oriented principles, and advanced features. It begins with the evolution of Java, basic syntax, data types, and control structures. Students will explore classes, objects, inheritance, and string handling to build modular and reusable code. The course further covers packages, interfaces, exception handling, and file I/O operations to enhance application robustness. Advanced topics include multithreading for concurrent execution and lambda expressions for functional-style programming. The course concludes with the Java Collections Framework and Stream API, enabling efficient manipulation of object groups and data processing. Emphasis is placed on applying Java features to solve real-world programming problems effectively.

Course Objectives

- To understand the fundamentals of Java programming, including its evolution, key features, object-oriented principles, control structures, and basic data handling using variables, operators, and arrays.
- To apply object-oriented concepts like classes, objects, inheritance, and string handling to develop modular Java programs.
- To apply packages and interfaces for modular programming, manage runtime errors through exception handling, and perform file input/output operations using byte and character streams in Java.
- To apply Java multithreading and lambda expression features for building efficient, concurrent, and functional programs.
- To apply the principles of Java Collections Framework and Stream API in developing programs that effectively manage and operate on groups of objects.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand Java's history, features, object-oriented concepts, control statements, and basic data types.	**K2**	1.7.1, 2.5.1, 3.5.6
CO2	Apply concepts of classes, objects, inheritance, and string handling to develop Java applications.	**K3**	1.7.1, 2.6.3, 3.5.1
CO3	Apply the concepts of packages, interfaces, exception handling, and I/O streams to develop efficient and modular Java programs.	**K3**	1.7.1, 2.5.2, 3.5.1, 5.4.1
CO4	Apply multithreading and lambda expressions in Java to develop efficient, concurrent, and functional programs.	**K3**	1.7.1, 2.7.2, 3.8.2, 5.4.2
CO5	Apply Java Collections Framework and Stream API for managing groups of objects and performing efficient operations on them.	**K3**	1.7.1, 2.7.1, 3.7.1, 5.4.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1										1	
CO2	2	3	1										2	2
CO3	1	2	2		3								2	2
CO4	1	2	3		2								2	2
CO5	2	2	1		3								2	2

Course Content

Unit – I : Fundamental Java Programming Constructs

Introduction, The History and Evolution of Java: Java History and Evolution, Java Features, Java's Magic: Byte Code, How Java differs from C and C++.
An Overview of Java: Object Oriented Programming, Two Paradigms, Principles of OOP, A First Simple Program, Two Control Statements, Java keywords.
Data Types, Variables and Arrays: The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Operators.

Unit – II : Classes, Objects, Inheritance, and String Handling

Introducing Classes and Objects: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this keyword, Garbage Collection, Overloading Methods, Using Objects as Parameters, Returning Objects, Understanding static, Introducing final, Introducing Nested and Inner Classes.
String Handling: The String Constructors, StringBuffer Class, StringTokenizer class.
Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance.

Unit – III : Packages and Interfaces, Exception Handling, and IO Streams

Packages & Interfaces: Packages, Defining a Package, Finding Package and CLASSPATH, A Short Package Example, Packages and Member Access, Importing Packages, Interfaces, Defining an Interface, Implementing Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces.
Exception handling: Exception Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, throw, throws, finally, Creating Your Own Exception Subclasses
I/O streams: The Byte Streams - InputStream, OutputStream, FileInputStream, FileOutputStream, The Character Streams - Reader, Writer, FileReader, and FileWriter.

Unit – IV : Multithreading and Lambda Expressions

Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization.
Lambda Expressions: Introducing Lambda Expressions, Block Lambda Expressions, Generic Functional Interfaces, Passing Lambda Expressions as Arguments, Lambda Expressions and Exceptions, Lambda Expressions and Variable Capture, Method References.

Unit – V : Collections Framework and Stream API

Collections Framework: Collections Overview, List Interface, Set Interface, Map Interface, ArrayList Class, LinkedList Class, HashSet Class, HashMap Class, TreeMap Class.
The Stream API: Stream Basics, Reduction Operations, Using Parallel Streams, Mapping, Collecting, Iterators and Streams.

Text Books

1. Herbert Schildt, Danny Coward, “Java: The Complete Reference”, Thirteenth Edition, McGrawHill, 2023.

Reference Books

1. Herbert Schildt, Dale Skrien, “Java Fundamentals A Comprehension Introduction”, Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2017.
2. E Balaguruswamy, ”Programming with Java”, Seventh Edition, Mc Graw Hill 2023.
3. Paul J. Dietel and Dr.Harvey M. Deitel, “Java How to Program”, Eleventh Edition, Deitel & Associates, Inc.l , 2018.
4. Timothy Budd, “Understanding Object Oriented Programming with Java”,Updated edition, Pearson Education, 2013.
5. Kathy Sierra & Bert Bates, ”Head First Java”, 2nd Edition, Oreilly.

Web Resources

1. **NPTEL**, ”Programming in Java,” Computer Science and Engineering, [Online]. Available: `https://archive.nptel.ac.in/courses/106/105/106105191/`. [Accessed: Feb. 25, 2025].
2. **NPTEL**, ”Data Structure and Algorithms using Java,” Computer Science and Engineering, [Online]. Available: `https://onlinecourses.nptel.ac.in/noc24_cs96/preview`. [Accessed: Feb. 25, 2025].
3. **Coursera**, ”Java Programming and Software Engineering Fundamentals,” [Online]. Available: `https://www.coursera.org/specializations/java-programming`. [Accessed: Feb. 25, 2025].
4. **Coursera**, ”Programming in Java: A Hands-on Introduction Specialization,” [Online]. Available: `https://www.coursera.org/specializations/hands-on-java`. [Accessed: Feb. 25, 2025].

COURSE CODE: 24CS203
SOFTWARE ENGINEERING

Course Category:	Professional Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-0
Pre-requisites:	—	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course provides an overview of the software engineering discipline, introducing the student to the fundamental principles and methods in software engineering. The course teaches the student various-methods and models to gather the system requirements, analyze and model the specified requirements both functional and non-functional requirements including system constraints. The course also aims at teaching various existing design models and patterns for different domains. Design methodologies including structured design and object-oriented design are also covered. Students will learn the implementation and testing concepts in developing a successful software solution that meets the specified requirements.

Course Objectives

- To understand the Nature of Software
- To design Class-Based and Component-Level Models
- To evaluate and Implement Testing Strategies for Different Software Types
- To apply Software Engineering Knowledge to implement Real-World Projects
- To apply various software testing strategies.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand the basics of software engineering.	**K2**	1.7.1,2.5.1, 2.5.2, 2.6.4, 2.7.1
CO2	Understand the different software engineering process models.	**K2**	1.7.1,2.5.1, 2.5.2, 2.6.4, 2.7.1
CO3	Apply analysis model for any given application.	**K3**	1.7.1,2.5.1,2.7.1,3.5.1, 3.5.2,3.5.6
CO4	Apply design model for any given application.	**K3**	1.7.1,2.5.1,2.6.4 3.5.1,3.8.1
CO5	Apply different testing techniques.	**K3**	1.7.1,2.5.1,2.6.4, 3.5.1,3.6.2,3.8.2

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3											2	2
CO2	2	3											2	2
CO3	2	2	3										1	2
CO4	2	2	3										1	2
CO5	2	2	3										1	2

Course Content

Unit – I : Process Models and Agile Development

Introduction: The Nature of Software, The changing nature of software, the Software Process, Software Engineering Practice, Software Development Myths.
Process models: Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models.
Agile Development: What Is Agility? Agility and the Cost of Change. What Is an Agile Process? Extreme Programming (XP) Other Agile Process Models, A Tool Set for the Agile Process.

Unit – II : Requirements Engineering

Understanding Requirements: Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Negotiating Requirements, Requirements monitoring, and Validating Requirements
Requirements Modeling(Scenarios, Analysis Classes): Scenario Based Methods: Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case, Class based methods, Identifying Analysis classes, Specifying attributes, Defining operators, Class-Responsibility-Collaborator Modeling, Associates and Dependencies, Analysis Packages

Unit – III : Requirements Modeling & Design Concepts

Requirements Modeling(Flow and Behavior): Behavior, Patterns, And Web apps: Creating a Behavioral Model, Identifying events with Use Cases, State Representations, Patterns for Requirements Modeling, Requirements Modeling for Web and Mobile Apps
Design Concepts: Design within the Context of Software Engineering, the Design Process, Design Concepts, the Design Model.

Unit – IV : Software Design

Architectural Design: Software Architecture, Architectural Genres, Architectural Styles, Architectural Considerations, Architectural Decisions, Architectural Design.
Component-Level Design: What Is a Component? Designing Class-Based Components, Conducting Component Level Design, and Component level design for Web Apps, Component Level Design for Mobile Apps.
User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Web app and Mobile Interface Design.

Unit – V : Software Testing

Software Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software,
Testing Conventional Applications: Software Testing Fundamentals, Internal and External Views of Testing, White Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing

Text Books

1. Roger S. Pressman, Bruce R.Maxim, "Software Engineering a practitioners approach" 8th edition, McGraw-Hill Publication, 2019.

Reference Books

1. Ian Somerville, "Software Engineering". 9th ed, Pearson Education. 2011.
2. Carlo Ghezzi, Mehdi Jazayeri and Dino Mandrioli, "Fundamentals of Software Engineering".2 ed, PHI. 2009
3. RajibMall, Fundamentals of Software Engineering. 3 ed, PHI. 2009.

Web Resources

1. **NPTEL**, "Lecture Series on Software Engineering," Department of Computer Science & Engineering, IIT Bombay. [Online]. Available:`https://nptel.ac.in/courses/106101061/2`. [Accessed: Mar. 9, 2025].
2. **NPTEL**, "Software Engineering," by Dr. B. Lavanya, Assistant Professor, University of Madras. [Online]. Available: `https://onlinecourses.swayam2.ac.in/cec20_cs07/preview`. [Accessed: Mar. 9, 2025].
3. **NPTEL**, "Software Engineering Basics," [Online]. Available: `https://www.youtube.com/watch?v=sB2iQSvrcG0`. [Accessed: Mar. 9, 2025].

COURSE CODE: 24CS204
OPERATING SYSTEMS

Course Category:	Program Core (PC)	**Credits:**	4
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-2
Pre-requisites:	Programming using 'C'	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course provides a comprehensive introduction to understand the underlying principles, techniques and approaches which constitute a coherent body of knowledge in operating systems. In particular, the course will consider inherent functionality and processing of program execution. The emphasis of the course will be placed on understanding how the various elements that constitute an operating system interact and provides services for execution of application software.

Course Objectives

- To understand OS structures and process management, including system calls, scheduling, and interprocess communication.
- To analyze CPU scheduling and synchronization, covering scheduling algorithms, thread management, and classic synchronization problems.
- To comprehend deadlock concepts and handling, focusing on prevention, avoidance, detection, and recovery strategies.
- To explore memory management techniques, including address binding, paging, swapping, and fragmentation handling.
- To apply OS concepts to practical scenarios, implementing process management, scheduling, synchronization, deadlocks, and memory allocation.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Identify the basic components of an Operating System engineering.	**K2**	1.7.1,2.5.1, 2.5.2, 2.6.4, 2.7.1
CO2	Apply CPU Scheduling and disk scheduling algorithms to achieve specific criteria	**K3**	1.7.1,2.5.1, 2.5.2, 2.6.4, 2.7.1
CO3	Apply analysis model for any given application.	**K3**	1.7.1,2.5.1,2.7.1,3.5.1, 3.5.2,3.5.6
CO4	Analyze the mechanisms used for process synchronization and handling deadlocks	**K4**	1.7.1,2.5.1,2.6.4 3.5.1,3.8.1
CO5	Analyze virtual memory techniques & File system Implementation techniques	**K4**	1.7.1,2.5.1,2.6.4, 3.5.1,3.6.2,3.8.2

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2													
CO2	1	2	1										1	
CO3	1	2	2										1	
CO4	1	2	2										1	
CO5	1	2	2										1	

Course Content

Unit – I : Introduction and Operating System Structures

Introduction: Operating Systems, Computer-System Organization, Computer-System Architecture, Operating-System Operations, Distributed Systems, Free and Open-Source Operating Systems.
Operating-System Structures: Operating-System Services, User and Operating-System Interface, System Calls, System Services, Operating-System Design and Implementation, Operating-System Structure, Building and Booting an Operating System.

Unit – II : Process Management

Processes and Threads: Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication, IPC in Shared-Memory Systems, IPC in Message-Passing Systems, Threads Overview, Multithreading Models, Pthreads, Threading Issues.
CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms (FCFS, SJF, RR, Priority, Multilevel Queue, Multilevel Feedback Queue), Multi-Processor Scheduling.

Unit – III : Process Synchronization

Synchronization Tools: Background, The Critical-Section Problem, Peterson's Solution, Hardware Support for Synchronization, Mutex Locks, Semaphores, Monitors, Classic Problems of Synchronization.
Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Unit – IV : Memory Management

Main Memory: Background, Contiguous Memory Allocation, Paging, Structure of the Page Table, Swapping.
Virtual Memory: Background, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing.

Unit – V : Storage Management and File System

Mass-Storage Structure: Overview of Mass-Storage Structure, HDD Scheduling (FCFS, SCAN, C-SCAN), RAID Structure.
File-System Interface: File Concept, Access Methods, Directory Structure
File-System Implementation: File-System Structure, File-System Operations, Directory Implementation, Allocation Methods.
File-System Internals: File Systems, File-System Mounting, Partitions and Mounting, File Sharing

List of Programming Tasks

1. Introduction to Linux Command Line Interface and Shell Utilities.
2. Practicing Essential Windows PowerShell Commands Using Batch Scripts.
3. Implementation of Fundamental UNIX System Calls for Process and File System Management.
4. Simulation of FCFS, SJF (Preemptive & Non-Preemptive), Round Robin Scheduling Algorithms.
5. Simulation of Priority Scheduling (Preemptive & Non-Preemptive.
6. Real-Time Scheduling – EDF and Rate Monotonic Scheduling (RMS).
7. Simulating the Critical Section Problem & Implementing Peterson's Solution.
8. Implementing Producer-Consumer Problem using Semaphores.
9. Solving Readers-writers problem using synchronization tools.
10. Solving the Dining Philosophers Problem.
11. Simulate Banker's Algorithm for Deadlock Avoidance.
12. Simulate memory allocation strategies like First Fit, Best Fit, and Worst Fit.
13. Simulate logical to physical address translation using fixed-size pages and frames.
14. Implement and compare FIFO, LRU, and Optimal page replacement algorithms.
15. Simulate disk scheduling algorithms like FCFS, SSTF, SCAN, C-SCAN to calculate total head movement.
16. Simulate and compare File Allocation Methods including Contiguous Allocation, Linked Allocation & Indexed Allocation.
17. Implement free space tracking methods: Bit vector, Linked list & Grouping.

Text Books

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, "Operating SystemConcepts", 10th Edition, John Wiley & Sons Pvt. Ltd, 2018.

Reference Books

1. William Stallings, "Operating System: Internals and Design Principles", 6thEdition 2009.
2. Andrew S.Tanenbaum, "Modern Operating Systems", 3rdEdition, PHI, 2008.

Web Resources

1. **NPTEL**, "Lecture Series on Operating Systems," Department of Computer Science & Engineering, IIT Kharagpur. [Online]. Available: `https://nptel.ac.in/courses/106/105/106105214/`. [Accessed: Mar. 9, 2025].

2. **Stanford University**, "Lecture Notes on Operating Systems," Department of Computer Science. [Online]. Available: `https://www.scs.stanford.edu/21wi-cs140/notes/`. [Accessed: Mar. 9, 2025].

3. **IIT Bombay**, "Lecture Notes on Operating Systems," Department of Computer Science & Engineering. [Online]. Available: `https://www.cse.iitb.ac.in/~mythili/os/`. [Accessed: Mar. 9, 2025].

COURSE CODE: 24CS281
OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB

Course Category:	Program Core (PC)	**Credits:**	1.5
Course Type:	Practical	**Lecture -Tutorial-Practice:**	0-0-3
Pre-requisites:	Programming using 'C' Lab	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	60 40 100

Course Description

The course provides hands-on experience in developing applications using Java, focusing on core and advanced object-oriented programming concepts. The course begins with the installation and basic setup of the Java Development Kit (JDK) and guides students through writing, compiling, and executing simple Java programs. It introduces control statements, primitive data types, arrays, type conversions, and object-oriented principles such as classes, objects, constructors, method overloading, and string handling. Students will gain practical knowledge of inheritance, method overriding, dynamic method dispatch, exception handling, and modular programming using packages and interfaces. The course also covers file handling through byte and character streams. In the advanced part of the lab, students will explore multithreading, thread priorities, lambda expressions, and generic functional interfaces. The course concludes with the implementation of the Java Collections Framework and the Stream API for processing data effectively. This lab course is designed to strengthen students' programming skills, improve problem-solving abilities, and prepare them to develop scalable, maintainable Java applications in real-world scenarios.

Course Objectives

- To familiarize with the installation and basic structure of Java programs, including primitive data types and control structures.
- To introduce and develop understanding of arrays, object-oriented programming concepts such as classes, objects, constructors, method overloading, inheritance, method overriding, and dynamic method dispatch.
- To equip with the knowledge of modular programming using packages, interfaces, and exception handling mechanisms.
- To develop applications with the concepts of multithreading and lambda expressions.
- To provide hands-on experience with generic functional interfaces, and Java collection framework including Stream API.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Apply the basic concepts of Java including installation, data types, control statements, and arrays.	**K3**	1.7.1, 2.6.3, 3.5.1
CO2	Apply OOP principles, string handling and inheritance.	**K3**	1.7.1, 2.5.2, 3.5.1, 5.4.1
CO3	Apply the concepts of packages, interfaces, exception handling, and stream-based file input/output.	**K3**	1.7.1, 2.5.2, 3.5.1, 5.4.1
CO4	Apply the concepts of multithreading and lambda expressions.	**K3**	1.7.1, 2.7.1, 3.7.1, 5.4.2
CO5	Apply the concepts of Java collections framework and Stream API.	**K3**	1.7.1, 2.7.1, 3.7.1, 5.4.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1										1	
CO2	2	3	1										2	2
CO3	1	2	2		3								2	2
CO4	1	2	3		2								2	2
CO5	2	2	1		3								2	2

Course Content

Task 1: Installation, Simple Program and Control Statements

- **Program 1:** Installation of Java and Execution of a Simple Hello World Program.
- **Program 2:** Implement a program to demonstrate the usage two control statements (if statement and for loop).

Task 2: Primitive Types, Type Conversions and Type Promotions

- **Program 1:** Implement a program to demonstrate the eight primitive types of data.
- **Program 2:** Implement a program to demonstrate type conversions and type promotions

Task 3: Arrays

- **Program 1:** Implement a program to demonstrate a two-dimensional array.
- **Program 2:** Implement a program by applying the concepts of arrays for a given use case.

Task 4: Classes, Objects and Constructors

- **Program 1:** Implement a program to demonstrate classes and objects.
- **Program 2:** Implement a program to demonstrate constructors and this keyword.

Task 5: Method Overloading and String Handling

- **Program 1:** Implement a program to demonstrate method overloading.
- **Program 2:** Implement a program to demonstrate String, StringBuffer and StringTokenizer class.

Task 6: Inheritance, Method Overriding and Dynamic Method Dispatch

- **Program 1:** Implement a program to demonstrate different types of inheritance and super keyword.
- **Program 2:** Implement a program to demonstrate method overriding and dynamic method dispatch. .

Task 7: Packages, Interfaces and Exceptions

- **Program 1:** Implement a program to demonstrate packages and interfaces.
- **Program 2:** Implement a program to demonstrate built-in exceptions and custom exception.

Task 8: Byte Streams and Character Streams

- **Program 1:** Implement a program to demonstrate byte streams.
- **Program 2:** Implement a program to demonstrate character streams.

Task 9: Threads, Multiple Threads and Thread Priorities

- **Program 1:** Implement a program to demonstrate creation of threads and multiple threads.
- **Program 2:** Implement a program to demonstrate thread priorities.

Task 10: Generic Functional Interfaces and Lambda Expressions

- **Program 1:** Implement a program to demonstrate generic functional interfaces.
- **Program 2:** Implement a program to demonstrate passing lambda expressions as arguments.

Task 11: Collection Classes

- **Program 1:** Implement a program to demonstrate ArrayList Class, LinkedList Class, HashSet Class.
- **Program 2:** Implement a program to demonstrate HashMap Class, TreeMap Class.

Task 12:The Stream API

- **Program 1:** Implement a program to demonstrate reduce operations in Stream API.
- **Program 2:** Implement a program to demonstrate iterators and streams in Stream API.

Text Books

1. Herbert Schildt, Danny Coward, “Java: The Complete Reference”, Thirteenth Edition, McGrawHill, 2023.

Reference Books

1. Herbert Schildt, Dale Skrien, “Java Fundamentals A Comprehension Introduction”, Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2017.
2. E Balaguruswamy, ”Programming with Java”, Seventh Edition, Mc Graw Hill 2023.
3. Paul J. Dietel and Dr.Harvey M. Deitel, “Java How to Program”, Eleventh Edition, Deitel & Associates, Inc.l , 2018.
4. Timothy Budd, “Understanding Object Oriented Programming with Java”,Updated edition, Pearson Education, 2013.
5. Kathy Sierra & Bert Bates, ”Head First Java”, 2nd Edition, Oreilly.

Web Resources

1. **NPTEL**, "Programming in Java," Computer Science and Engineering, [Online]. Available: `https://archive.nptel.ac.in/courses/106/105/106105191/`. [Accessed: Feb. 25, 2025].
2. **NPTEL**, "Data Structure and Algorithms using Java," Computer Science and Engineering, [Online]. Available: `https://onlinecourses.nptel.ac.in/noc24_cs96/preview`. [Accessed: Feb. 25, 2025].
3. **Coursera**, "Java Programming and Software Engineering Fundamentals," [Online]. Available: `https://www.coursera.org/specializations/java-programming`. [Accessed: Feb. 25, 2025].
4. **Coursera**, "Programming in Java: A Hands-on Introduction Specialization," [Online]. Available: `https://www.coursera.org/specializations/hands-on-java`. [Accessed: Feb. 25, 2025].

COURSE CODE: 24CS282
DIGITAL LOGIC DESIGN LAB

Course Category:	Engineering Sciences (ES)	**Credits:**	1.5
Course Type:	Theory	**Lecture -Tutorial-Practice:**	0-0-3
Pre-requisites:	—	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	60 40 100

Course Description

This laboratory component is designed to help students gain practical experience in implementing digital circuits and systems based on the theory learned in the classroom. The experiments cover a wide range of topics, from basic logic gates to more complex combinational and sequential circuits, and also introduce the use of FPGA for digital design.

Course Objectives

- To understand and verify the functionality of logic gates and their realization using universal gates.
- To design and implement basic arithmetic circuits, code converters, and comparators
- To implement combinational using multiplexers, decoders, and encoders.
- To develop and analyze sequential circuits, including flip-flops, counters, and shift registers.
- To introduce FPGA-based logic design and implement digital circuits using Xilinx Spartan-6.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Apply knowledge of logic gates and universal gates for circuit realization.	**K3**	1.2.1, 1.7.1
CO2	Apply combinational logic concepts to design arithmetic circuits, code converters, and comparators.	**K3**	1.2.1, 1.7.1, 2.7.2
CO3	Analyze combinational circuits using MSIs such as multiplexers, decoders, and encoders.	**K4**	1.7.1, 2.7.1, 2.7.2, 3.7.1 ,3.8.1
CO4	Analyze various types of flip-flops, counters, and shift registers.	**K4**	1.7.1, 2.7.1, 2.7.2, 3.7.1 ,3.8.1
CO5	Analyze logic gate realization and combinational circuit design using FPGA platforms.	**K4**	1.7.1, 2.7.1, 2.7.2, 3.7.1 ,3.8.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2													
CO2	2	2												
CO3	2	2	2											1
CO4	2	2	2											1
CO5	1	2	2											

Course Content

Task 1: Realization of All logic gates using universal gates.

- Verification of logic gates from DIGITAL IC'S.
- Realization of logic gates using NAND and NOR.

Task 2: Design and Implementation of Arithmetic circuits.

- Design and Implementation of half adder and half sub tractor.
- Design and Implementation of half adder and half sub tractor.

Task 3: Design and implement different types of code converters

- Design and implement i) Binary to Gray ii) Gray to Binary code converters
- Design and implement i) BCD to EX-3 ii) EX-3 to BCD code converters.

Task 4: Design and implementation of magnitude comparators

- Design and implement single bit comparator.
- Design and implement single bit comparator.

Task 5: Implementation of Decoders and encoders

- Implementation of i) 2X4 Decoder ii)3X8 Decoder iii) BCD to Decimal Decoder iv) BCD to 7 segment Display
- Implementation of i) 4x2 Encoder ii) Octal to Binary encoder iii) Decimal to BCD encoder.

Task 6: Implementation of Multiplexer and De Multiplexer.

- Implementation of i) 2X1 MUX ii)4X1 MUX
- Implementation of i) 1X2 De MUX ii)1X4 De MUX

Task 7: Implementation of all types of FLIP-FLOPS using gates.

- Implementation of SR latch using NAND & NOR
- Implementation of SR, JK, D, T flip flops.
- Implementation of Master-Slave JK Flip flop

Task 8: Design of Synchronous counters

- Design and implementation of synchronous up, synchronous down counter and Up-down Counters .
- Design and implementation of synchronous MOD counters.

Task 9: Design of Asynchronous counters.

- Design of Asynchronous up and down counters.
- Design and implementation of Asynchronous Mod counters.

Task 10: Design of Ring-counter and Johnson counter.

- Design and implementation of 4-bit Ring counter.
- Design and implementation of 4-bit Johnson counter.

Task 11: Verification of Shift-Registers using flip flops.

- Verification of i) SISO ii) SIPO Shift registers
- Verification of i) PISO ii) PIPO Shift registers

Task 12: Logic Design with FPGA

- Introduction to Xilinx Spartan-6 FPGA Development Board.
- realization of logic gates
- Realization of combinational logic circuits.

Text Books

1. M.Morris Mano, Digital Logic & Computer Design 1 e/d reprint, Pearson education, 2016
2. M.Morris Mano, Michael D Ciletti Digital Design with an Introduction toVerilog HDL 5th e/d, Pearson education, 2013

Reference Books

1. A. Anand Kumar, Switching Theory and Logic Design, 2nd Edition, PHI,2013
2. Charles H.Roth , Fundamentals of Logic Design, 6/e, Cengage learning,2010
3. Computer Architecture and Organization Designing for Performance, William Stallings, Ninth edition, Pearson Education series, 2014.

Web Resources

1. **NPTEL**, "Digital Systems," Prof. N. Goel, Department of Electrical Engineering, IIT Ropar, [Online]. Available: `https://nptel.ac.in/courses/108/106/108106177/`. [Accessed: Feb. 25, 2025].
2. **NPTEL**, "Digital Systems," Prof. N. J. Rao, Department of Electrical Engineering, IISc Bangalore, NPTELWEB Notes, [Online]. Available: `https://nptel.ac.in/courses/106/108/106108099/`. [Accessed: Feb. 25, 2025].

COURSE CODE: 24UC201
UNIVERSAL HUMAN VALUES-II

Course Category:	Mandatory Course (MC)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	2-1-0
Pre-requisites:	UHV-I (Student Induction Programme)	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

The course is mandated by AICTE for all B.Tech. students of all branches, preferably in the second year. It is intended to facilitate the development of a holistic and humane world vision. This course employs an innovative and effective methodology of self-exploration, self-verification on one's own right. It is presented as a systematic set of universal, rational and verifiable proposals about human reality, about the inherent harmony in the human being, the family, society, the entire nature and existence. It draws out the value or role of human being in the harmony at all these levels, which is essentially the scope of ethical human conduct. It further helps to find resolution of present-day challenges. The issues in professional ethics are analyzed in the context of the understanding of harmony. While handling the course, the teacher is also a co-explorer along with the students.

Course Objectives

- Help the students appreciate the essential complementarily between 'values' and 'skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- Facilitate the development of a holistic perspective among learners towards life and profession.
- Facilitate the right understanding of happiness and prosperity based on correct understanding of human reality and the rest of existence.
- Identify that a holistic perspective forms the basis of universal human values and movement towards value-based living in a natural way.
- Highlight plausible implications of holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Apply the right understanding of the concepts of value education and basic human aspirations through self-exploration for the fulfillment of human aspirations.	**K3**	6.3.1, 6.4.1, 7.3.1, 8.4.1, 9.5.2, 9.5.3, 10.5.1, 12.5.2
CO2	Analyse various aspects of the human being as the combination of Self and Body for attaining harmony at the level of human being (individual)	**K4**	6.3.1, 6.4.1, 7.3.1, 8.4.1, 9.5.2, 9.5.3
CO3	Apply the knowledge of nine universal values in human-human relationship for harmony at the level of family, and appreciate all the essential factors that help in attaining harmony at the level of society.	**K3**	6.3.1, 6.4.1, 7.3.1, 8.4.1, 9.5.2, 9.5.3, 10.5.1, 12.5.2
CO4	Differentiate the characteristics and activities of various orders of Nature and study the mutual fulfillment among them, and also identify the existence as co-existence at all levels	**K4**	6.3.1, 6.4.1, 7.3.1, 8.4.1, 9.5.2, 9.5.3, 10.5.1, 12.5.2
CO5	Present sustainable solutions to various challenges in society and Nature, and identify that the solutions are practicable	**K3**	6.3.1, 6.4.1, 7.3.1, 8.4.1, 9.5.2, 9.5.3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1						3						3		
CO2						3						3		
CO3						3			2	2		3		
CO4						3	3		2	2		3		
CO5						3	3	3	3	3		3		

Course Content

Unit – I :Introduction, Need, and Basic Guidelines

Purpose and Motivation: Recapitulation from UHV-I, Self-exploration: what is it?, its content and process, 'Natural acceptance' and experimental validation – as the process for self-exploration, Continuous happiness and prosperity – a look at basic human aspirations. Right understanding, relationship and physical facility – the basic requirements for fulfillment of aspirations of every human being with their correct priority, understanding happiness and prosperity correctly – a critical appraisal of the current scenario, method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Examples/Applications/Case Studies:

1. Examples to differentiate the meaning of happiness and prosperity in the current scenario and the meaning proposed in the course.
2. Case studies related to the basic aspirations assumed by the students and the real basic aspirations.

Exercises/Projects/Practices: Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Unit – II: Understanding Harmony in the Human Being – Harmony in Myself

Understanding Human Being: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' – happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.
Examples/Applications/Case Studies:

1. Examples to differentiate the functions and needs of both Self and Body.
2. Case studies related to the Sanyam and Health and correct appraisal of physical needs that provides clarity on the real meaning of prosperity.

Exercises/Projects/Practices: Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease.

Unit – III: Understanding Harmony in the Family and Society – Harmony in Human-Human Relationship

Understanding Values: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family.
Examples/Applications/Case Studies:

1. Examples for exploring the nine values in human-human relationships in family.
2. Case studies for visualizing universal harmonious order in society and universal order.

Exercises/Projects/Practices: Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Unit – IV :Understanding Harmony in Nature & Existence – Whole existence as Coexistence

Understanding the Nature Harmony: Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of Nature – recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.
Examples/Applications/Case Studies:

1. Examples to distinguish various units in all the four orders of Nature.
2. Case studies related to recyclability and self-regulation in Nature.

Exercises/Projects/Practices: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology, etc.

Unit – V: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Human Values: Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, humanistic constitution and humanistic universal order, Competence in professional ethics: a) ability to utilize the professional competence for augmenting universal human order, b) ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) at the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) at the level of society: as mutually enriching institutions and organizations.

Examples/Applications/Case Studies:

1. Examples for holistic technologies, management models and production systems.
2. Case studies related to production systems, management models and technologies.

Exercises/Projects/Practices: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an engineer or scientist, etc.

Text Books

1. R.R. Gaur, R. Sangal, G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books Private Limited, New Delhi, 2010.
2. R.R. Gaur, R. Asthana, G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics (2nd revised ed.), Excel Books Private Limited, New Delhi, 2019.

Reference Books

1. A. Nagaraj, Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, Human Values, New Age International Publishers, New Delhi, 2004.
3. Annie Leonard, The Story of Stuff: The Impact of Overconsumption on the Planet, Our Communities, and Our Health and How We Can Make It Better, Free Press, New York, 2010.
4. Mohandas Karamchand Gandhi, The Story of My Experiments with Truth: Mahatma Gandhi Autobiography, B.N. Publishing, 2008.
5. E.F. Schumacher, Small is Beautiful: A Study of Economics as if People Mattered, Vintage Books, London, 1993.
6. Cecile Andrews, Slow is Beautiful: New Visions of Community, New Society Publishers, Canada, 2006.
7. J.C. Kumarappa, Economy of Permanence, Sarva-Seva-Sangh Prakashan, Varanasi, 2017.
8. Pandit Sunderlal, Bharat Mein Angreji Raj, Prabhath Prakashan, Delhi, 2018.
9. Dharampal, Rediscovering India, Society for Integrated Development of Himalayas, 2003.
10. M.K. Gandhi, Hind Swaraj or Indian Home Rule, Navajivan Publishing House, Ahmedabad, 1909.
11. Maulana Abul Kalam Azad, India Wins Freedom: The Complete Version, Orient Blackswan, 1988.
12. Romain Rolland, The Life of Vivekananda and the Universal Gospel, Advaita Ashrama, India, 2010.

13. Romain Rolland, Mahatma Gandhi: The Man Who Became One with the Universal Being, Srishti Publishers & Distributors, New Delhi, 2002.

Web Resources

1. R.R. Gaur, R. Sangal, G.P. Bagaria, **A Foundation Course in Human Values and Professional Ethics**, [Online]. Available: `https://dokumen.pub/a-foundation-course-in-human\-values-and-professional-ethics-firstnbsped-9788174467812.html`. [Accessed: Jun. 13, 2025].

2. **AICTE**, "AICTE – SIP YouTube Channel," [Online]. Available: `https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ`. [Accessed: Jun. 13, 2025].

3. **AICTE**, "AICTE – UHV Teaching Learning Material," [Online]. Available: `https://fdp-si.aicte-india.org/download.php#1`. [Accessed: Jun. 13, 2025].

SEMESTER-IV

COURSE CODE: 24MA204
DISCRETE MATHEMATICS

Course Category:	Basic Sciences (BS)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-0
Pre-requisites:	Set theory and Functions	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course provides an in-depth exploration of fundamental concepts in propositional and predicate logic, advanced and basic counting techniques, digraphs and relations, group theory and graph theory. Emphasis is placed on applying these concepts to solve practical engineering problems.

Course Objectives

- To introduce propositional logic and predicate logic with quantifiers to validate arguments.
- To teach the methods of solving combinatorial problems.
- To generate functions and recurrence relations, solve homogeneous and inhomogeneous recurrence relations
- To explain the different types of relations, and Group homomorphism.
- To introduce various types of graphs, including isomorphism of graphs, graph coloring techniques and determine the chromatic number.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Apply Propositional logic and Predicate logic to infer statements to validate and determining Normal forms.	**K2**	1.2.1, 1.2.2, 2.6.3, 4.6.1
CO2	Apply basic counting techniques to solve combinatorial problems.	**K3**	1.2.1, 1.2.2, 2.6.3, 5.6.1
CO3	Solve the recurrence relations of homogeneous and in homogeneous.	**K4**	1.2.2, 2.6.3, 5.6.1, 5.6.3
CO4	Illustrate the types of different relations and Group homomorphism.	**K3**	2.5.2, 2.6.3,3.5.1
CO5	Analyze the properties, types and applications Isomorphism and chromatic number of graphs.	**K3**	1.2.1, 2.6.3, 5.6.1, 5.6.3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3			3				3					
CO2	3	3			3				3					
CO3	3	3			2				1					
CO4	3	3			2				1					
CO5	3	3												

Course Content

Unit – I :Propositional Calculus

Fundamentals of Logic: Propositions, Connectives, Propositional functions, Truth tables, Tautology, Contradiction, Logical equivalences, Normal forms, Logical inferences, Methods of proof of an implication. First Order Predicate Logic: Predicate, Quantifiers, Rules of inference for Quantified propositions.

Unit – II: Basics of Counting

Basics of Counting: Sum and product rules, Indirect counting, One to one correspondence, Combinations and permutations, Enumerating combinations and permutations with and without repetitions. Enumerating combinations and permutations with Constrained repetitions

Unit – III: Advanced Counting Techniques

Advanced Counting Techniques : Generating function of sequences, Recurrence relations, solving recurrence relations – substitution- Generating functions-The method of characteristic roots, Solution of in homogeneous recurrences relations.

Unit – IV :Relations and Digraphs & Group Theory

Relations and Digraphs & Group Theory: Relations and directed graphs, Special properties of binary relations, and ordering relations, paths and closures.
Group Theory: Groups- definition of a group, examples and elementary properties, sub groups, group homomorphism.

Unit – V: Graph Theory

Graph Theory: Introduction (graphs, sub graphs, circuits, trees) Sum of degrees' theorem, Isomorphism and sub graphs, planar graphs, Euler's formula, Multi graphs and Euler's circuits, Hamiltonian graphs, Grin-berg's theorem, Graph coloring, Chromatic numbers.

Text Books

1. J. L. Mott and A. Kandel, Discrete Mathematics for Computer Scientists and Mathematicians, 2nd ed. New Delhi, India: PHI, 1992.
2. N. Chandra Shekharan and M. Umaparvathi, Discrete Mathematics. New Delhi, India: PHI, 2010.

Reference Books

1. K. H. Rosen, Discrete Mathematics and Its Applications, 6th ed. New York, NY, USA: McGraw-Hill, 2007.
2. R. P. Grimaldi, Discrete and Combinatorial Mathematics, 4th ed. Upper Saddle River, NJ, USA: Pearson Education, 2003.

Web Resources

1. **NPTEL**, "Discrete Mathematical Structures," Prof. Kamala Krithivasan, Department of Computer Science and Engineering, IIT Madras, [Online]. Available: `http://nptel.ac.in/syllabus/syllabus.php?subjectId=106106094`. [Accessed:August 26, 2025].
2. **Coursera**, "Discrete Mathematics," Prof. Dominik Scheder, Department of Computer Science and Engineering, Shanghai Jiao Tong University, [Online]. Available: `https://www.coursera.org/learn/discrete-mathematics`. [Accessed: September 16, 2025].
3. **NPTEL**, "Discrete Mathematical Structures," Prof. Kamala Krithivasan, IIT Madras, [Online]. Available: `http://www.infocobuild.com/education/audio-video-courses/computerscience/DiscreteMathematicalStructures-IIT-Madras/lecture-16.html`. [Accessed: November 7, 2025].

COURSE CODE: 24CS205
DATABASE MANAGEMENT SYSTEMS

Course Category:	Program Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-0
Pre-requisites:	Data Structures	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course introduces the principles of database systems and the role of database users and architectures in modern computing. It covers SQL for defining, manipulating, and querying data with constraints, nested queries, and triggers. Students learn data modeling through ER diagrams and relational models, emphasizing integrity and normalization. The course explains schema refinement, functional dependencies, and database design for consistency. It also explores transaction management, concurrency control, and recovery techniques for reliable data systems. Overall, it builds conceptual understanding and practical skills in designing and managing efficient databases.

Course Objectives

- To understand the fundamental concepts, characteristics, and architecture of database systems.
- To apply relational data model principles and SQL operations for effective data handling.
- To apply relational algebra operations and database design techniques for structured data organization.
- To apply normalization and indexing methods to improve database efficiency and consistency.
- To apply transaction processing, concurrency control, and recovery mechanisms to ensure database reliability and integrity.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand the fundamental concepts of database systems, data models, and database architectures.	**K2**	1.7.1, 2.5.1, 2.7.1, 3.8.3
CO2	Apply relational data model concepts and construct SQL queries for data retrieval and manipulation.	**K3**	1.7.1,2.5.2, 2.6.3, 3.8.3
CO3	Apply relational algebra operations, ER modeling techniques for efficient database design	**K3**	2.5.2, 2.6.3, 3.8.2, 4.5.1
CO4	Apply normalization techniques and indexing methods to improve data consistency and performance.	**K3**	2.7.2, 3.6.2, 4.6.4
CO5	Apply transaction processing, concurrency control, and recovery mechanisms for maintaining data integrity.	**K3**	2.5.2, 3.6.2, 4.5.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1									3	1	
CO2	1	3	2									2	2	
CO3		3	2	1								2	2	
CO4		3	2	1								3	2	
CO5		3	2	1								2	2	

Course Content

Unit – I : INTRODUCTION TO DATABASES CONCEPTS AND ARCHITECTURE

Databases and Database Users: Introduction, Characteristics of Database Approach, Actors on the scene, workers behind the scenes, Advantage of using the DBMS Approach, A brief History of Database Application, when not to use a DBMS.
Database System concepts and Architecture: Data Models, Schemas and interfaces, Three-Schema Architecture and Data Independence, Data Language and interfaces, The Database System Environment, Centralized and Client/Server Architectures for DBMSs, Classification of Database Management Systems.

Unit – II: RELATIONAL DATA MODEL AND SQL

Relational Data Model: Relational Model concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations.
Basic SQL: SQL Data Definition and Data Types,The Form of a Basic SQL Query, Specifying Constraints in SQL, Basic Retrieval Queries in SQL,INSERT, DELETE, and UPDATE Statements in SQL, Additional Features of SQL, Views (Virtual Tables) in SQL , Cursors, Triggers, Procedures.

Unit – III: RELATIONAL ALGEGRA AND DATABASE DESIGN

Relational Algebra: Unary Relational Operations,Relational Algebra Operations from Set Theory, Binary Relational Operations, Additional Relational Operations, The Tuple Relational Calculus, The Domain Relational Calculus, Relational Database Design Using ER-to-Relational Mapping.
Entity Relationship Model: Introduction,Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and StructuralConstraints, Weak Entity Types,Refining the ER Design for the COMPANY Database,ER Diagrams, Naming Conventions, and Design Issues.

Unit – IV :NORMALIZATION AND INDEXING

Schema Refinement and Normal Forms: Introduction to schema refinement, Functional Dependencies, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other kinds of Dependencies.
Indexing: Types of single level ordered indexes, Multilevel Indexes, Dynamic Multilevel Indexes Using B-Tress and B+ Trees.

Unit – V: TRANSACTION PROCESSING, CONCURRENCY CONTROL AND RECOVERY

Transaction Processing: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Transaction Support in SQL.
Concurrency Control Techniques: Two-Phase Locking Techniques for ConcurrencyControl, Concurrency Control Based on Timestamp Ordering, Multi-version Concurrency Control Techniques.
Database Recovery Techniques: Recovery Concepts, NO-UNDO/REDO Recovery Techniques based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging,The ARIES Recovery Algorithm.

Text Books

1. R. Elmasri and S. B. Navathe, Database Management Systems, 6th ed. New Delhi, India: McGraw Hill Education / Pearson, 2011.
2. A. Silberschatz, H. F. Korth, and S. Sudarshan, Database System Concepts, 5th ed. New York, NY, USA: McGraw Hill, 2006.

Reference Books

1. C. J. Date, An Introduction to Database Systems, 8th ed. New Delhi, India: Pearson Education, 2004.
2. R. Ramakrishnan and J. Gehrke, Database Management Systems, 3rd ed. New York, NY, USA: McGraw Hill, 2003.
3. C. Coronel, S. Morris, and P. Rob, Database Principles: Fundamentals of Design, Implementation, and Management, Boston, MA, USA: Cengage Learning, 2013.

Web Resources

1. **Database Management System**, , IIT Kharagpur By Prof. Partha Pratim Das, Prof. Samiran Chattopadhyayhttps, [Online]. Available: `//nptel.ac.in/courses/106105175`. [Accessed: Oct, 16, 2025].
2. **Database Design** by Prof. S. Srinath, Prof. D. Janaki Ram, [Online]. Available: `https://nptel.ac.in/courses/10610609`. [Accessed: Oct 16, 2025].
3. **Introduction to Database Systems and Design**, IIT Madras, Prof. P.Sreenivasa Kumar, [Online]. Available: `https://nptel.ac.in/courses/106106095`. [Accessed: Oct 16, 2025].
4. Fundamentals of Database Systems, IIT Kanpur, by Prof. Arnab Bhattacharya,Available: `https://nptel.ac.in/courses/106104135`. [Accessed: Oct 16, 2025].

5. Databases: Relational Databases and SQL, Standford university by Prof. Jennifer ,Available: https://www.edx.org/learn/relational-databases/stanford-university-databases-relational-databases-and-sql?. [Accessed: Oct 25, 2025].

6. MIT OpenCourseWare, "Database Systems," Prof. Samuel Madden, Prof. Robert Morris, Prof. Michael Stonebraker, and Dr. Carlo Curino, Massachusetts Institute of Technology, ,Available: https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/. [Accessed: Oct 25, 2025].

COURSE CODE: 24CS206
COMPUTER NETWORKS

Course Category:	Basic Sciences (BS)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-0
Pre-requisites:	Operating Systems	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course provides a comprehensive understanding of Computer Networks, covering the fundamental concepts, architectures, protocols, and services that enable data communication in modern networks. It introduces the layered approach to networking through the OSI and TCP/IP reference models, exploring key aspects of each layer — from physical transmission media to advanced application protocols. Students will gain in-depth knowledge of data link and network layer mechanisms, including framing, error detection, flow control, routing, and congestion management. The course also examines media access control techniques, Ethernet standards, and internetworkingconcepts such as IPv4 and IPv6.At the transport and application layers, emphasis is placed on understanding TCP, UDP, SCTP, and core Internet services such as HTTP, DNS, and Email. Through theoretical foundations and protocol analysis, students will develop the skills required to design, analyze, and troubleshoot communication networks, preparing them for research and advanced applications in networking and distributed systems

Course Objectives

- To understand the fundamental concepts of computer networks, reference models, and transmission media used for data communication
- To understand the design principles, framing techniques, and error and flow control mechanisms of the data link layer.
- To apply various media access control methods, channelization techniques, and Ethernet standards in wired LANs.
- To apply the functions of the network layer, routing algorithms, congestion control mechanisms, and inter-networking protocols..
- To apply the roles of the transport and application layers, focusing on communication protocols and Internet services.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand the concepts related to network categories ,topologies, and reference models.	**K2**	1.2.1, 1.6.1, 1.7.1, 2.5.2
CO2	Understand the design issues and functionalities of data link layer	**K2**	1.6.1, 1.7.1, 2.5.2, 2.6.4
CO3	Apply various Media Access Control (MAC) techniques and LAN technologies	**K3**	1.6.1, 1.7.1, 2.5.2, 2.6.4
CO4	Apply routing algorithms, congestion control mechanisms and analyze internetworking concepts of network layer.	**K3**	1.6.1, 1.7.1, 2.5.2, 2.6.4
CO5	Apply transport layer and application layer protocols for specific applications.	**K3**	1.7.1, 2.5.2,2.6.4, 3.6.2

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3											2	3
CO2	2	3											2	3
CO3	1	2	3										1	3
CO4	1	2	3										1	3
CO5	1	2	2										1	3

Course Content

Unit – I :Introduction and Physical Layer

Introduction: Networks-Criteria Structures, Network Types- LAN,WAN, Switching, Internet
Reference Models: The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models.
Physical Layer: Transmission Media: Guided Media- Twisted-pair cable, Coaxial cable and Fiber optic cable, Unguided media – Radio waves, Microwaves, Infrared.

Unit – II: Data link Layer

Data link layer: Design issues – Services provided to network layer, Framing,error control, flow control, error detection and correction codes, Elementary Data Link Layer protocols: Simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel, Sliding window protocol:One bit, Go back N, Selective repeat-Stop and wait protocol.
Data link layer Protocols: High-level Data Link Control (HDLC), Point to Point Protocol (PPP).

Unit – III: Medium Access Control Protocols and Wired LANS

Media Access Control: Random Access: ALOHA, Carrier Sense Multiple Access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance, Controlled Access: Reservation, Polling, Token Passing, Channelization-Frequency Division Multiple Access(FDMA), Time Division Multiple Access(TDMA), Code Division Multiple Access(CDMA).
Ethernet: Classical Ethernet Physical Layer, MAC Sublayer Protocol, Performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet.

Unit – IV : Network Layer

Design Issues: Store and Forward Packet Switching, Services provided to the Transport layer, Implementation of Connectionless Service, Implementation of Connection Oriented Service, Comparison of Virtual Circuit and Datagram Networks.
Routing Algorithms: The Optimality principle, Distance vector, Link state, Path vector, Unicast routing protocols- Internet Structure, RIP, OSPF.
Congestion Control Algorithms: General principles of congestion control, Congestion prevention polices, Approaches to Congestion Control-Traffic Aware Routing- Admission Control-Traffic Throttling-Load Shedding.
Quality of Service: Characteristics, Flow Control, INTSERV, DIFFSERV. Network layer in the internet: IP Version 4 protocol, IP addresses, IP Version 6, Internet Control Protocols

Unit – V: Transport Layer and Application Layer

The Transport Layer: Transport layer protocols: Introduction-services, port number, User data gram protocol-User datagram, UDP services, UDP applications, Transmission control protocol- TCP services, TCP features,Segment, A TCP connection, Windows in TCP, Flow Control, Error Control, Congestion control, Timers (T1)
Application Layer: World Wide Web, HTTP, Electronic mail-Architecture, web based mail,E-mail security, SSH- Components & Applications, Domain Name System.

Text Books

1. Behrouz A.Fourozan, Data Com¬¬munications and Networking. 4th Edition, TATA McGraw Hill, 2007
2. Andrew S Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Education, 2011.

Reference Books

1. J.F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 6th Edition, Pearson Education, 2012.

Web Resources

1. **NPTEL**, "Computer Networks and Internet Protocol," Prof. Sowmya Kanti Ghosh, Department of Computer Science and Engineering, IIT Kharagpur, [Online]. Available: `https://nptel.ac.in/courses/106105183`. [Accessed: Apr. 18, 2025].
2. **MIT OpenCourseWare**, "Computer Networks," Prof. Hari Balakrishnan, Massachusetts Institute of Technology, [Online]. Available: `https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/`. [Accessed: Apr. 18, 2025].
3. **IIT Kanpur**, "Computer Networks," Dheeraj, Department of Computer Science and Engineering, IIT Kanpur, [Online]. Available: `http://www.cse.iitk.ac.in/users/dheeraj/cs425`. [Accessed: Apr. 18, 2025].

COURSE CODE: 24CS207
COMPUTER ORGANIZATION AND ARCHITECTURE

Course Category:	Program Core (PC)	**Credits:**	4
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-1-0
Pre-requisites:	Digital Logic Design	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

The course emphasizes the structure, functionality, and efficient operation of modern computer systems.It begins with the study of basic computer structure, functional units, and instruction execution. Students learn about number representation, arithmetic operations, and the hardware implementation of fundamental arithmetic algorithms. The course further explores the processing unit, control design, pipelining, and vector processing for performance improvement. It also covers memory hierarchy concepts, including cache and virtual memory, along with input/output organization, data transfer techniques, interrupts, and standard I/O interfaces. By the end of the course, students will be able to understand, analyze, and apply architectural principles to the design and efficient functioning of computer systems.

Course Objectives

- To understand the basic structure of computers and the organization of machine instructions.
- To apply the concepts of number representation and arithmetic algorithms for performing basic arithmetic operations using digital hardware.
- To apply the concepts of instruction execution and parallel processing for efficient system performance.
- To apply memory system concepts, including RAM, ROM, cache, and virtual memory, for efficient storage, retrieval, and overall system performance.
- To apply I/O and interrupt concepts for effective device communication and system performance.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand the roles of computer components, describe instruction types and addressing modes, and interpret the flow of instructions within the system.	**K2**	1.7.1, 2.7.1, 3.7.1
CO2	Apply arithmetic algorithms to implement addition, subtraction, multiplication, and division operations using digital hardware.	**K3**	1.2.1, 1.2.2, 2.5.3, 3.8.3
CO3	Apply instruction execution concepts to demonstrate pipelining and vector processing for enhanced computational performance.	**K3**	2.7.1, 3.7.1, 4.5.1
CO4	Apply RAM, ROM, cache, and virtual memory concepts to demonstrate memory operations and analyze their effects on system performance.	**K3**	2.7.2, 3.6.2, 4.5.1
CO5	Apply I/O and interrupt concepts to demonstrate device communication and analyze standard I/O buses.	**K3**	2.6.2, 3.8.2, 4.4.3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1										2	1
CO2	2	3	1										2	1
CO3		2	1	3									2	1
CO4		2	3	1									2	1
CO5		2	3	1									2	1

Course Content

Unit – I : Basic Structure of Computers

BasicStructure of Computers: Computer Types, Functional Units: Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts, Bus Structures, Software,Performance.
Machine Instructions and Programs: Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Stacks and Queues, Subroutines, Additional Instructions, Encoding of Machine Instructions.

Unit – II: Arithmetic Unit

Numbers, Arithmetic Operations, and Characters: Number Representation, Addition of Positive Numbers, Addition and Subtraction of Signed Numbers, Overflow in Integer Arithmetic, Characters.
Arithmetic: Introduction, Addition and Subtraction: Addition and Subtraction with Signed-Magnitude Data, Hardware Implementation, Hardware Algorithm, Addition and Subtraction with Signed-2's Complement Data.
Multiplication Algorithms: Hardware Implementation for Signed-Magnitude Data, Hardware Algorithm, Booth Multiplication Algorithm.
Division Algorithms: Hardware Implementation for Signed-Magnitude Data, Divide Overflow, Hardware Algorithm.

Unit – III: Basic Processing Unit

Basic Processing Unit: Fundamental concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control, Microprogrammed Control.
Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline: Four Segment Instruction Pipeline, Data Dependency, Handling of Branch Instructions, RISC Pipeline: Three Segment Instruction Pipeline, Delayed Load, Delayed Branch, Vector Processing: Vector Operations, Matrix Multiplications, Memory Interleaving, Superscalar Processors, Supercomputers,Array Processor: Attached Array Processor, SIMD Array Processor.

Unit – IV : Memory System

The Memory System: Basic Concepts, Semiconductor RAM Memories:Internal Organisation of memory chips, Static Memories, Read-Only Memories: ROM, PROM, EPROM, EEPROM, Flash Memory, Speed, Size, and Cost,
Cache Memories: Mapping Functions, Replacement Algorithms, Examples of Mapping Techniques,Performance Considerations: Interleaving, Hit Rate and Miss Penalty, Caches on the Processor Chips,Virtual Memories: Address Translation,Secondary Storage: Magnetic Hard Disks.

Unit – V: Input / Output Interfaces and Organization

Input/Output Interfaces: I/O Bus and Interface Modules, I/O versus Memory Bus, Isolated Memory-Mapped I/O, Asynchronous Data Transfer: Strobe Control, Handshaking, Asynchronous Serial Transfer, Asynchronous Communication Interface, Modes of Transfer: Programmed I/O, Interrupt-Initiated I/O, Priority Interrupt: Daisy-Chaining Priority, Parallel Priority Interrupt.
Input/Output Organization: Accessing I/O Devices, Interrupts: Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions,Direct Memory Access: Bus Arbitration, Buses: Synchronous Bus, Asynchronous Bus, Standard IO Interfaces: Peripheral Component Interconnect (PCI) Bus, SCSI Bus and Universal Serial Bus (USB).

Text Books

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, McGraw-Hill.
2. M. Morris Mano, Computer System Architecture, 3rd Edition, Pearson Education 2007

Reference Books

1. William Stallings, Computer Organization and Architecture: Designing for Performance, 10^{th} Edition, Pearson Education.
2. Andrew S. Tanenbaum, Structured Computer Organization.
3. Patterson & Hennessy, Computer Organization and Design: The Hardware/Software Interface

Web Resources

1. **NPTEL**, "Computer Architecture and Organization," Prof. Indranil Sengupta and Prof. Kamalika Datta, IIT Kharagpur, [Online]. Available:`https://onlinecourses.nptel.ac.in/noc22_cs88/preview`. [Accessed: Apr. 18, 2025].
2. **Coursera**, "Computer Architecture," David Wentzlaff, Princeton University, [Online]. Available: `https://www.coursera.org/learn/comparch`. [Accessed: Apr. 18, 2025].
3. **MIT OpenCourseWare**, "Computer System Architecture," Dr. Joel Emer, Prof. Krste Asanovic, and Prof. Arvind, Massachusetts Institute of Technology, [Online]. Available: `https://ocw.mit.edu/courses/6-823-computer-system-architecture-fall-2005/`. [Accessed: Apr. 18, 2025].

COURSE CODE: 24CS209
ARTIFICIAL INTELLIGENCE

Course Category:	Program Core (PC)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-2
Pre-requisites:	–	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course introduces the fundamental concepts and foundations of Artificial Intelligence and intelligent agents. It covers various search strategies including uninformed, informed, and adversarial approaches for problem solving. Students learn knowledge representation using propositional and first-order logic and perform logical inference. The course also explores probabilistic reasoning and decision-making under uncertainty using Bayesian networks. Finally, it familiarizes students with different learning approaches and the structure of Agentic AI frameworks in modern AI systems.

Course Objectives

- To understand the fundamental concepts, history, and foundations of Artificial Intelligence (AI), the architecture and functioning of intelligent agents.
- To apply general AI problem-solving methods including various search algorithms to model and solve practical tasks.
- To apply the principles of propositional and first-order logic and apply inference techniques for reasoning in AI.
- To apply reasoning methods using probabilistic approaches and Bayesian networks for uncertainty problems and learn about knowledge representation techniques used to represent data in AI.
- To understand the different forms of machine learning techniques and the concept of Agentic AI systems, emphasizing their frameworks, features, and practical relevance.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Apply uninformed, informed (heuristic), and adversarial search algorithms for solving state-space and game-playing problems.	**K2**	1.2.1, 1.6.1, 1.7.1, 2.5.2, 3.5.1
CO2	Apply HTML and CSS techniques to create well-formatted, user-friendly, and interactive web pages.	**K3**	1.2.1, 1.7.1, 2.5.1, 2.5.3, 2.6.4,2.7.1, 3.6.2
CO3	Apply propositional and first-order logic concepts to represent knowledge and perform logical inference.	**K3**	1.2.1, 1.7.1, 2.7.1, 2.7.2, 3.5.1
CO4	Apply probabilistic reasoning techniques for decision-making under uncertainty and demonstrate the use of appropriate knowledge representation methods.	**K3**	2.7.2, 3.6.2, 4.5.1
CO5	Understand various learning approaches and understand the structure and significance of Agentic AI frameworks in modern AI systems.	**K2**	1.2.1, 1.7.1, 2.5.3, 4.4.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1										3	2
CO2	1	3	2										3	2
CO3	2	3	1										3	2
CO4	1	3	2										3	2
CO5	3	1		2									3	2

Course Content

Unit – I : Introduction to Artificial Intelligence and Intelligent Agents

Introduction to Artificial Intelligence: AI definition, Foundations of AI,History of AI, The State of the Art, Risks and Benefits of AI.
Intelligent agents: Agents and Environments, Good Behavior: The concept of Rationality,Nature of Environments, and Structure of Agents.

Unit – II: Problem Solving

Problem Solving by Searching: Problem-Solving Agents, Example Problems: 8 puzzle problem and water jug problem, Searching for Solutions, Uninformed Search Strategies, Informed Search Strategies, Heuristic Functions.
Search in Complex Environments: Local Search and Optimization Problems: Hill Climbing Search, Simulated Annealing, Search with Nondeterministic Actions: AND-OR search trees.
Adversarial Search: Game Theory, Optimal Decision in Games:Mini-Max Search Algorithm, Alpha-Beta pruning.

Unit – III: Logical Reasoning

Logic: Propositional Logic: A very Simple Logic, Propositional Theorem Proving, First Order Logic:Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic.
Inference in First Order Logic: Propositional vs. First-Order Inference, Unification and First Order Inference, Forward Chaining, Backward Chaining, Resolution.

Unit – IV : Knowledge Representation and Uncertainty in AI

Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.
Uncertainty: Acting under Uncertainty, Basic Probability Notation, Bayes Rule and its use, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks.

Unit – V: Learning and Agentic AI

Learning: Forms of Learning: Supervised and Unsupervised Learning, Artificial Neural Networks, Explanation-based Learning, Statistical Learning, Reinforcement Learning: Introduction, Active Reinforcement Learning, Passive Reinforcement Learning.
The Five Levels of AI Agents: From Automation to Autonomy:AI Agent's Capabilities, The SPAR Framework, The Agentic AI Progression Framework- Level 0 Manual Operation, Level 1 Rule-based Automation, Level 2 Intelligent Automation, Level 3- Agentic Workflows, Level 4- Semi Autonomous Agentic Systems, Level 5- Fully Autonomous Agentic Systems, The Evolution of Autonomy: A Natural Progression, The Agentic AI Progression Framework: More than Just Maturity, Inherent Limitations of AI Agents.

List of Programming Tasks

Task 1: To understand and implement different types of intelligent agents that interact with their environment and make rational decisions.

- Program 1: Write a program to implement a simple reflex agent for the Vacuum Cleaner problem.
- Program 2: Write a program to implement a Utility-Based Agent that evaluates multiple possible actions and selects the one that maximizes its performance measure.

Task 2: To implement uninformed AI search techniques.

- Program 1: Solve the 8-Puzzle Problem using Breadth-First Search (BFS).
- Program 2: Solve the Water Jug Problem using Depth-First Search (DFS).

Task 3: To implement informed search techniques in AI.

- Program 1: Solve the 8-Puzzle Problem using A* Search Algorithm.
- Program 2: Write a program to find the shortest path in a weighted graph using the Greedy Best-First Search Algorithm, where the heuristic estimates the distance to the goal node.

Task 4: To implement local search optimization algorithms in AI.

- Program 1: Implement the Hill Climbing Algorithm for the Monkey and Banana Problem to reach the goal state by iterative improvement.
- Program 2: Implement the Simulated Annealing Algorithm to find the optimal solution in the N-Queens Problem, where the objective is to place N queens on a chessboard such that no two queens attack each other.

Task 5: To implement Adversarial search techniques in AI.

- Program 1: Implement the Mini–Max Algorithm for Tic-Tac-Toe.
- Program 2: Implement Alpha-Beta Pruning for Tic-Tac-Toe.

List of Programming Tasks

Task 6: Introduction to PROLOG.

- Program 1: Study of input/output operations, operators and compound goals in PROLOG.
- Program 2: Study of string operations in PROLOG.

Task 7: To represent knowledge and perform logical inference using PROLOG.

- Program 1: Write a PROLOG program to represent family relationships (e.g., parent, child, and sibling) and use rules and queries to infer new relationships such as grandparent or cousin.
- Program 2: Write a PROLOG program to implement a simple expert system that infers decisions based on given facts and rules.

Task 8: To represent and reason using different knowledge representation schemes.

- Program 1: Write a PROLOG program to represent knowledge using Semantic Networks.
  - Define relationships such as is_a, part_of, etc.
  - Example: Represent that a robin is a bird, a bird is an animal, and a robin can fly.
  - Query relationships to infer inherited properties (e.g., "Can a robin fly?").
- Program 2: Write a PROLOG program to represent knowledge using Frames.
  - Represent attributes of objects in a hierarchical frame structure.
  - Example: Represent vehicles $\rightarrow$ car $\rightarrow$ electric car with properties like wheels, fuel, speed.
  - Query to retrieve inherited slot values (e.g., "What is the fuel type of an electric car?").

Task 9: To represent uncertain or rule-based knowledge using PROLOG and perform inference.

- Program 1: Write a PROLOG program to represent and infer medical diagnosis rules.
- Program 2: Write a PROLOG program to represent and reason using fuzzy-like reasoning (approximate certainty).

Task 10: To perform reasoning under uncertainty using probabilistic approaches.

- Program 1: Write a Python program to apply Bayes Theorem for decision-making under uncertainty.
- Program 2: Write a Python program to implement a Naive Bayes Classifier for a simple dataset.

Task 11: To understand and implement different learning approaches in AI.

- Program 1: Write a Python program to implement Supervised Learning using the Linear Regression algorithm. Use a small dataset and plot the regression line using matplotlib.
- Program 2: Write a Python program to implement Unsupervised Learning using the K-Means Clustering algorithm. Use a simple 2D dataset and visualize clusters using matplotlib.

List of Programming Tasks

Task 12: To simulate an Agentic AI Framework using PROLOG that demonstrates perception, reasoning, and goal-directed behavior.

- Program 1: Design a delivery agent that picks up and delivers packages efficiently between connected locations. The agent should reason about which location to visit next based on delivery priorities.
- Program 2: Design a cleaning robot agent that decides whether to clean or recharge based on its energy level and room dirtiness — combining perception, reasoning, and utility-based action.

Text Books

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson, Third Edition, Prentice-Hall, 2009.
2. Pascal Bornet and Jochen Wirtz, "Agentic Artificial Intelligence- Harnessing AI Agents to Reinvent Business, Work and Life, 2025.

Reference Books

1. K. Knight and E. Rich, Artificial Intelligence, 3rd ed. TMH Publication.
2. M. Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Farrar, Straus and Giroux, ISBN: 0374257833.

Web Resources

1. **NPTEL**, "An Introduction to Artificial Intelligence," Prof. Mausam, Computer Science and Engineering, [Online]. Available: `https://onlinecourses.nptel.ac.in/noc22_cs56/preview` [Accessed: Oct. 17, 2025].
2. **NPTEL**, "Artificial Intelligence: Concepts and Techniques," Prof. V. Susheela Devi, Computer Science and Engineering, [Online]. Available: `https://onlinecourses.nptel.ac.in/noc25_cs159/preview` [Accessed: Oct. 17, 2025].
3. **Coursera**, "Introduction to Artificial Intelligence," Rav Ahuja, [Online]. Available: `https://www.coursera.org/learn/introduction-to-ai` [Accessed: Oct. 17, 2025].
4. **Coursera**, "AI for Everyone," Andrew Ng, [Online]. Available: `https://www.coursera.org/learn/ai-for-everyone` [Accessed: Oct. 17, 2025].
5. **Agentic Frameworks**: The Complete Guide to the Systems Used in Building Autonomous Agents," [Online]. Available: `https://www.moveworks.com/us/en/resources/blog/what-is-agentic` [Accessed: Oct. 17, 2025].

COURSE CODE: 24CS283
DATA BASE MANAGEMENT SYSTEMS LAB

Course Category:	Program Core (PC)	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0-0-3
Pre-requisites:	Data Structures	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	60 40 100

Course Description

This laboratory course provides practical experience in designing and managing relational databases using SQL and PL/SQL. Students learn to create, modify, and query tables with constraints and relationships. The lab covers advanced SQL features such as joins, subqueries, views, and normalization techniques up to BCNF. It emphasizes database design through ER modeling and schema conversion. PL/SQL programming is practiced through procedures, functions, cursors, loops, and triggers. The course concludes with developing a real-time database application integrating file and media handling.

Course Objectives

- To gain basic knowledge of DBMS starting from installing and configuring the Oracle Database Server.
- To apply students with skills to design and manage database structures using SQL commands.
- To apply enable students to create and control users, roles, and security mechanisms in a database environment.
- To apply develop the ability to use SQL functions, triggers, joins, subqueries, and views for efficient data handling.
- To apply the basic concepts of backup, recovery, indexing, and transaction management for reliable database operation.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand and gain the insights for Database server installation	**K3**	1.6.1,1.7.1,5.4.1
CO2	Apply basic SQL commands on database.	**K3**	1.7.1, 2.7.1, 3.6.2 5.4.1
CO3	Apply knowledge of SQL commands at moderate level for different roles, constraints, operators and functions in SQL.	**K3**	1.7.1, 2.7.1,3.6.2
CO4	Apply PL/SQL constructs including control statements, procedures, and triggers.	**K3**	1.7.1,2.5.2,3.8.2
CO5	Apply basic backup operations and transaction controls for maintaining consistency	**K3**	1.7.1, 2.8.1,3.6.3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3				1								1	2
CO2	1	3	2										2	2
CO3	1	3	2										2	2
CO4	1	3	2										3	3
CO5	1	3	2										2	3

Course Content

Task 1: Installation and basics of DB

- **Program 1:** Installation of Oracle Database Server.
- **Program 2:** Study of Database Concepts

Task 2: DDL Commands

- **Program 1:** Create tables using CREATE TABLE with suitable constraints.
- **Program 2:** Modify and delete tables using ALTER TABLE and DROP TABLE.

Task 3: DML Commands

- **Program 1:** Insert records into tables using INSERT with various forms.
- **Program 2:** Update and delete rows using UPDATE and DELETE.

Task 4: Database, Users and Roles

- **Program 1:** Create database or tablespace; create and delete users.
- **Program 2:** Manage privileges and roles using GRANT and REVOKE.

Task 5: Constraints

- **Program 1:** Implement NOT NULL, UNIQUE, CHECK, DEFAULT, PRIMARY KEY, FOREIGN KEY.
- **Program 2:** Add and drop constraints using ALTER TABLE; test violations.

Task 6: SQL Functions

- **Program 1:** Demonstrate number, aggregate, and character functions.
- **Program 2:** Demonstrate conversion and date functions .

Task 7: Operators in SQL

- **Program 1:** Use arithmetic, comparison, and logical operators.
- **Program 2:** Use special and set operators (BETWEEN, IN, LIKE, UNION, etc.

Task 8: SQL Triggers, cursors and procedures

- **Program 1:** Create a row-level trigger to audit INSERT, audit UPDATE/DELETE operations.
- **Program 2:** Write a PL/SQL program for implementing cursors and procedures

Task 9: Joins

- **Program 1:** Write queries using inner join and natural join.
- **Program 2:** Write queries using outer joins (left, right, full)

Task 10: Subqueries and Views

- **Program 1:** Write simple, nested, and correlated subqueries.
- **Program 2:** Create, update, and query views.

Task 11: Grouping, Ordering, Indexing

- **Program 1:** Use GROUP BY and HAVING with conditions.
- **Program 2:** Create and use indexes and apply ORDER BY.

Task 12:Backup, Recovery and Transactions

- **Program 1:** Use ROLLBACK, COMMIT, and SAVEPOINT.
- **Program 2:** Demonstrate logical backup and recovery using CTAS, RENAME, and DROP.

Text Books

1. R. Elmasri and S. B. Navathe, Database Management Systems, 6th ed. New Delhi, India: McGraw Hill Education / Pearson, 2011.
2. A. Silberschatz, H. F. Korth, and S. Sudarshan, Database System Concepts, 5th ed. New York, NY, USA: McGraw Hill, 2006.

Reference Books

1. Oracle: The Complete Reference, Oracle Press, New York, NY, USA: McGraw Hill Education, 2019.
2. N. Shah, Database Systems Using Oracle, 2nd edition, New Delhi, India: PHI Learning, 2016.
3. C. J. Date, An Introduction to Database Systems, 8th ed. New Delhi, India: Pearson Education, 2004.
4. R. Ramakrishnan and J. Gehrke, Database Management Systems, 3rd ed. New York, NY, USA: McGraw Hill, 2003.

5. C. Coronel, S. Morris, and P. Rob, Database Principles: Fundamentals of Design, Implementation, and Management, 10th edition Boston, MA, USA: Cengage Learning, 2014.

Web Resources

1. **NPTEL**, "Introduction to Database Systems and Design," Prof. P. Sreenivasa Kumar, IIT Madras. [Online]. Available: `https://nptel.ac.in/courses/106106095`. [Accessed: Oct. 16, 2025].
2. **MIT OpenCourseWare**, "Database Systems," Massachusetts Institute of Technology. [Online]. Available: `https://ocw.mit.edu/courses/6-5830-database-systems-fall-2023/`. [Accessed: Oct. 25, 2025].
3. **edX**, "Databases: Relational Databases and SQL," Stanford University, Prof. Jennifer Widom. [Online]. Available: `https://www.edx.org/learn/relational-databases/stanford-university-databases-relational-databases-and-sql`. [Accessed: Oct. 25, 2025].
4. **MIT OpenCourseWare**, "Database Systems," Prof. Samuel Madden, Prof. Robert Morris, Prof. Michael Stonebraker, and Dr. Carlo Curino. [Online]. Available: `https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/`. [Accessed: Oct. 25, 2025].
5. **Harvard University**, "Designing Database Schemas," CS50 SQL. [Online]. Available: `https://cs50.harvard.edu/sql/notes/3/`. [Accessed: Oct. 25, 2025].

COURSE CODE: 24CS284
COMPUTER NETWORKS LABORATORY

Course Category:	Program Core (PC)	**Credits:**	1.5
Course Type:	Laboratory	**Lecture -Tutorial-Practice:**	0-0-3
Pre-requisites:	Operating Systems Lab	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	60 40 100

Course Description

This course provides hands-on exposure to the principles and practices of computer networking, emphasizing both theoretical understanding and practical implementation of core networking concepts. Students will explore the OSI and TCP/IP reference models, analyze real-time network traffic using Wireshark, and implement key data link and network layer protocols such as framing, error detection, error correction, and sliding window mechanisms.Through CCNA-based simulation exercises in Cisco Packet Tracer, learners will gain experience in configuring switches, routers, IP addressing (IPv4/IPv6), subnetting, and securing network devices using SSH and password mechanisms. The course also covers routing algorithms, congestion control techniques, and network diagnostics using tools like Nmap for security analysis.By completing the programming tasks and configuration labs, students will develop the technical skills required to design, implement, analyze, and troubleshoot small- to medium-scale computer networks in real-world environments.

Course Objectives

- To analyze the functioning of the OSI and TCP/IP reference models through protocol examination and network traffic analysis.
- To analyzedata link layer mechanisms such as framing, error detection and correction, and flow control protocols.
- To analyse network devices including switches and routers using Cisco Packet Tracer.
- To applyalgorithms for routing, congestion control, and shortest path computation.
- To analyze network analysis tools like Wireshark and Nmap for monitoring, diagnosing, and securing computer networks.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Analyze network communication with the knowledge of OSI and TCP/IP reference models.	**K3**	1.6.1,1.7.1,5.4.1
CO2	Analyze data link layer functionalities including framing, error detection, correction, and flow control techniques.	**K3**	1.7.1, 2.7.1, 3.6.2 5.4.1
CO3	Analyze network devices such as switches and routers using Cisco Packet Tracer to establish secure and efficient network connectivity.	**K3**	1.7.1, 2.7.1,3.6.2
CO4	Apply routing algorithms and congestion control techniques to optimize data transmission and network performance.	**K3**	1.7.1,2.5.2,3.8.2
CO5	Analyze network analysis with the security tools like Wireshark and Nmap to monitor, test, and secure computer networks effectively.	**K3**	1.7.1, 2.8.1,3.6.3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3			2								1	3
CO2	2	3			2								1	3
CO3	2	3			2								1	3
CO4	2	3			2								1	3
CO5	2	3			2								1	3

Course Content

Task 1: Investigation of Layered Models and Implementation of Data Link Layer Framing Techniques

- **Program 1:** CCNA-1: Investigate OSI and TCP reference models in action. i) Examine HTTP Web Traffic ii) Display Elements of the TCP/IP Protocol Suite
- **Program 2:** Write a Program to implement the data link layer framing methods such as i) Character stuffing ii) bit stuffing.

Task 2: Implementation of Data link layer protocols

- **Program 1:** Write a Program to implement data link layer error control methods - checksum, the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP.
- **Program 2:** Write a program for Hamming Code generation for error detection and correction

Task 3: Implementation of sliding window protocols

- **Program 1:** Write a Program to implement Sliding window protocol for Go-back-N and for Selective repeat.
- **Program 2:** Write a Program to implement Stop and Wait Protocol.

Task 4: Configuration of Switch, End Device and Router

- **Program 1:** CCNA-1- Basic Switch and End Device Configuration Configure Initial Switch Settings (PT 2.5.5) & Basic Switch and End Device Configuration (PT 2.9.1);
- **Program 2:** Configure Initial Router Settings (PT 10.1.4), Connect a Router to a LAN (PT 10.3.4) & Troubleshoot Default Gateway Issues (10.3.5)

Task 5: Configuration of IPv4 and Sub-Netting

- **Program 1:** CCNA-1: IPv4 Addressing - Subnet an IPv4 Network (PT 11.5.5), Subnetting Scenario (PT 11.7.5),
- **Program 2:** VLSM Design and Implementation Practice (PT 11.9.3), Design and Implement a VLSM Addressing Scheme (PT 11.10.1)

Task 6: Configuration of IPv6 addressing and Sub-Netting

- **Program 1:** Configure IPv6 Addressing.
- **Program 2:** Implement a Subnetted IPv6 Addressing Scheme. .

Task 7: Implementation of Routing algorithms and congestion control algorithms

- **Program 1:** Write a program for congestion control using leaky bucket algorithm
- **Program 2:** Implement Dijkstra's algorithm to compute the Shortest path through a graph.

Task 8: Troubleshooting of IPv4 and IPv6 Addressing

- **Program 1:** CCNA-1: Verify IPv4 and IPv6 Addressing (PT 13.2.6), Use Ping and Traceroute to Test Network Connectivity (PT 13.2.7),
- **Program 2:**Use ICMP to Test and Correct Network Connectivity (PT 13.3.1)

Task 9: Implementation of Distance Vector Routing algorithm and broadcast tree

- **Program 1:** Write a Program to implement Broadcast tree by taking subnet of hosts.
- **Program 2:** Write a Program to implement Distance vector routing algorithm by obtaining routing table at each node (Take an example subnet graph with weights indicating delay between nodes).

Task 10: Device Security

- **Program 1:** CCNA-1: Device Security - Configure Secure Passwords and SSH (PT 16.4.6).
- **Program 2:** Secure Network Devices (PT 16.5.1)

Task 11: Analyze network analysisthrough wireshark

- **Program 1:** Wireshark i) Packet Capture Using Wire shark ii) Starting Wire shark
- **Program 2:** Wireshark i) Viewing Captured Traffic ii) Analysis and Statistics & Filters.

Task 12: Monitoring and testing trough Nmap Operating System

- **Program 1:** Running Nmap, Network Scanning and Host Discovery
- **Program 2:** Nmap Operating System Detection

Text Books

1. Andrew S Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Education, 2011.

2. Behrouz A.Fourozan, Data Communications and Networking. 4th Edition, TATA McGraw Hill, 2007.

Reference Books

1. J.F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 6th Edition, Pearson Education, 2012.

Web Resources

1. **NPTEL**, "Computer Networks and Internet Protocol," Prof. Sowmya Kanti Ghosh, IIT Kharagpur. [Online]. Available: `https://nptel.ac.in/courses/106105183`.[Accessed: Apr. 18, 2025].

2. **MIT OpenCourseWare**, "Computer Networks," Prof. Hari Balakrishnan, Massachusetts Institute of Technology. [Online]. Available: `https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/`. [Accessed: Apr. 18, 2025].

3. **IIT Kanpur**, "Computer Networks," Dheeraj, Lecture Notes. [Online]. Available: `http://www.cse.iitk.ac.in/users/dheeraj/cs425`.[Accessed: Apr. 18, 2025].

COURSE CODE: 24EN281

ENGLISH FOR PROFESSIONALS

Course Category:	HS	**Credits:**	1
Course Type:	Laboratory	**Lecture-Tutorial-Practice:**	0-0-2
Pre-requisites:	Intermediate English	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	60 40 100

Course Description

English for Professionals course covers functional English grammar, elocution, extempore speaking, short story writing, storytelling, debating, vocabulary building, biographical sketches, Versant Test practice, blog writing, etiquette, team building, and leadership. It emphasizes practical exercises, voice modulation, articulation, quick thinking, effective communication, cultural awareness, and developing an online presence and confidence in professional settings. This comprehensive curriculum aims to enhance students' linguistic abilities, interpersonal skills, and leadership qualities for success in diverse professional environments.

Course Objectives

- Explain the fundamentals of language in terms of grammar and lexical resources in communication.
- Familiarize students with effective listening and speaking while communicating with others.
- Introduce language skills, etiquettes, team building, and leadership in professional and social contexts with clarity and accuracy.
- Develop coherence, cohesion, and precision in formal written communication.
- Illustrate grammar and vocabulary enhancement using the Versant Test.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Recall the fundamentals of language in terms of grammar and lexical resources in communication.	**K1**	–
CO2	Understand how to listen, reflect, and speak effectively while communicating with others.	**K2**	–
CO3	Apply language skills, etiquettes, team building, and leadership in professional and social contexts with clarity and accuracy.	**K3**	–
CO4	Analyze and produce ideas with coherence, cohesion, and precision in formal written communication.	**K4**	–
CO5	Evaluate grammar and vocabulary proficiency using the Versant Test and related tasks.	**K5**	–

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2							2	3		2			
CO2	2							2	3		2			
CO3	2							2	3		2			
CO4	2							2	3		2			
CO5	2							2	3		2			

Course Content

Unit – I: Functional English Grammar

Topics: Modal verbs, subject–verb agreement, active and passive voice, reported speech, question tags, and practice exercises. (2 Hours)

Unit – II: Elocution

Topics: Definition and importance of elocution, key components, voice modulation, articulation, posture and gestures, practice activities. (2 Hours)

Unit – III: Extempore

Topics: Introduction and significance, developing quick thinking, communication skills, confidence building, strategies for effective speaking, practice sessions. (2 Hours)

Unit – IV: Story Telling

Topics: Narratives through spoken words, gestures and expressions, importance of culture, story-telling techniques, vocal modulation, pacing, gestures and facial expressions, practice. (2 Hours)

Unit – V: Debate

Topics: Introduction, understanding the structure and purpose of a debate, developing basic debating skills, do's and don'ts, practice debates. (2 Hours)

Unit – VI: Team Building & Leadership

Topics: Team building traits – vision, integrity, decisiveness, confidence, empathy, flexibility, innovation; leadership activities and reflection. (2 Hours)

Unit – VII: Corporate Etiquette

Topics: Social etiquette, business etiquette, telephone etiquette, dining etiquette, summary and role plays. (2 Hours)

Unit – VIII: Short Story Writing

Topics: Introduction, key characteristics, brevity, theme, types of short stories, creating relatable characters, guided writing. (2 Hours)

Unit – IX: Blog Writing

Topics: Purpose in the digital world, different types of blogs, benefits, building online presence, sharing knowledge, connecting with others, practice blogging. (2 Hours)

Unit – X: Biographical Sketch

Topics: Purpose, overview of a person's life, identifying key events, organizing and presenting a biographical sketch, conclusion. (2 Hours)

Unit – XI: Vocabulary

Topics: Idiomatic expressions, idioms with body parts, animal idioms, colour idioms, phrasal verbs, one-word substitutes, analogies, practice exercises. (2 Hours)

Unit – XII: Versant Test

Topics: Overview of the Versant Test, purpose and importance, format of the test, types of questions, practice sessions. (2 Hours)

Lab Manual

1. *English for Professionals Lab Manual.*

Reference Books

1. Wren & Martin, *English Grammar and Composition.* S. Chand & Company, 2023.
2. Dale Carnegie, *The Quick and Easy Way to Effective Speaking.* Rupa Publications, 2016.
3. Richard A. Spears, *McGraw–Hill's Dictionary of American Idioms and Phrasal Verbs.* McGraw Hill, 2005.
4. Jon M. Ericson, James J. Murphy, Raymond Bud Zeuschner, *The Debater's Guide* (3rd ed.). Southern Illinois University Press, Carbondale, 2003.
5. S. P. Dhanavel, *English and Soft Skills.* Orient Blackswan, 2010.
6. Barun K. Mitra, *Personality Development and Soft Skills.* Oxford University Press, 2011.

Web Resources

1. Pearson, "Versant English Test for Professionals," [Online]. Available: `https://www.pearson.com/languages/hr-professionals/versant.html`.

AI Tools

1. Grammar and Syntax Mastery: Wordvice, Busuu.
2. Speaking Fluency and Clarity: ELSA Pro, ELSA Speak.

3. Communication Strategies: Speechease, Rosetta Stone.
4. Story Writing Techniques: Plot Generator, Narrativa.
5. Vocabulary Acquisition: Quizlet, Anki.
6. Writing Proficiency: eAngel, Scribens, Grammarly.

COURSE CODE: 24UC202

PROFESSIONAL ETHICS

Course Category:	Mandatory Course (MC)	**Credits:**	0
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Pre-requisites:	—	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	– – 100

Course Description

Through this course, students are exposed to ethical principles, professional responsibilities, and the social dimensions of engineering practice. It emphasizes moral reasoning, ethical decision-making, and the development of professional integrity in engineering contexts. Using case studies and theoretical frameworks, students explore the ethical challenges engineers face in technology development, safety, environmental sustainability, and global practice.

Course Objectives

- To understand the scope and significance of engineering ethics and moral values in professional life.
- To develop skills for analyzing moral dilemmas and applying ethical theories to real-world engineering problems.
- To recognize the importance of professional responsibility, safety, rights, and risk management in engineering projects.
- To gain awareness of global and societal issues, including environmental and computer ethics, intellectual property, and corporate responsibility.
- To understand the basic principles of contract management and the legal framework governing engineering practice.

Course Outcomes

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

	Course Outcomes	BTL	POI
CO1	Explain the moral and ethical theories related to engineering practice.	**K2**	–
CO2	Apply ethical reasoning to professional dilemmas and responsibilities.	**K3**	–
CO3	Analyze case studies to evaluate ethical decision-making and safety practices.	**K4**	–
CO4	Assess global and environmental issues affecting engineering ethics.	**K4**	–
CO5	Apply and interpret the principles of the Indian Contract Act in professional contexts.	**K3**	–

Course articulation matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2						3				
CO2					3		3				
CO3			3			3	3				
CO4							3			2	2
CO5							3			2	

(1–Low, 2–Medium, 3–High) (WK1)

Course Content

Unit – I: Engineering Ethics

Topics: Senses of "Engineering Ethics"; variety of moral issues; types of inquiry; moral dilemmas; moral autonomy: Kohlberg's theory, Gilligan's theory; consensus and controversy; models of professional roles; theories about right action; self-interest, customs and religion; use of ethical theories.

Unit – II: Engineering as Social Experimentation

Topics: Engineering as experimentation; learning from the past; engineers as responsible experimenters; codes of ethics; a balanced outlook on law; the Challenger disaster – a case study.

Unit – III: Safety, Responsibilities and Rights

Topics: Safety and risk; assessment of safety and risk; risk–benefit analysis; reducing risk; Three Mile Island and Chernobyl case studies; collegiality and loyalty; respect for authority; collective bargaining; confidentiality; conflicts of interest; occupational crimes; professional rights; employee rights; intellectual property rights (IPR); discrimination.

Unit – IV: Global Issues

Topics: Multinational corporations; environmental ethics; computer ethics; weapons development; engineers as managers; engineers as professionals; managing conflicts; consulting engineers; engineers as expert witnesses and advisors; moral leadership; sample code of ethics (specific to a particular engineering discipline).

Unit – V: General Principles of Contracts Management

Topics: Indian Contract Act; concept of contract; essential elements of a valid contract; types of contract – valid contract, invalid contract, other types; offer – types of offer, legal rules for offer; acceptance – legal rules for acceptance; consideration – legal rules as to consideration; stranger to contract; capacity to contract.

Text Books

1. Mike Martin and Roland Schinzinger, *Ethics in Engineering*, McGraw Hill, New York, 1996.

2. Govindarajan M., Natarajan S., Senthil Kumar V. S., *Engineering Ethics*, Prentice Hall of India, New Delhi, 2004.

Reference Books

1. Baum, R. J. and Flores, A. (eds.), *Ethical Problems in Engineering*, Center for the Study of the Human Dimensions of Science and Technology, Rensselaer Polytechnic Institute, Troy, New York, 1978.

2. Beabout, G. R., Wennemann, D. J., *Applied Professional Ethics: A Developmental Approach for Use with Case Studies*, University Press of America, Lanham, MD, 1994.

3. Dutt, *Indian Contract Act*, Eastern Law House, 1994.

Web Resources

1. Scribd, "Professional Development with Applied Ethics – Module 1," [Online]. Available: `https://www.scribd.com/document/552528071/professional-developmentd`. [Accessed: Dec. 4, 2025].

2. UNODC, "Integrity and Ethics: Module 14 – Professional Ethics," [Online]. Available: `https://grace.unodc.org/grace/uploads/documents/academics/Integrity_and_Ethics_Module_14_Professional_Ethics.pdf`. [Accessed: Dec. 4, 2025].

3. Online Ethics Center, "Three Mile Island Nuclear Accident (Case Study)," [Online]. Available: `https://onlineethics.org/cases/three-mile-island-nuclear-accident`. [Accessed: Dec. 4, 2025].

4. TutorialsPoint, "Engineering Ethics – Tutorial," [Online]. Available: `https://www.tutorialspoint.com/engineering_ethics/index.htm`. [Accessed: Dec. 4, 2025].

5. SlideShare, "Indian Contract Act 1872 (Presentation)," [Online]. Available: `https://www.slideshare.net/slideshow/indian-contract-act-1872-14444088/14444088`. [Accessed: Dec. 4, 2025].

HONORS

QUANTUM SYSTEMS AND COMPUTING

COURSE CODE: 24OE520A
INTRODUCTION TO QUANTUM COMPUTING

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture -Tutorial-Practice:**	4-0-0
Pre-requisites:	Digital Logic and Design	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course provides a comprehensive introduction to the principles and foundations of quantum computing. It begins with the evolution and history of the field, explaining fundamental concepts such as superposition, entanglement, and quantum measurement, supported by essential linear algebra for representing quantum states. Students learn to describe and analyze single- and multi-qubit systems, quantum gates, tensor products, and interference phenomena. The course further explores quantum circuits, entanglement mechanisms, quantum key distribution, and teleportation, leading to the study of major quantum algorithms including Grover's, Deutsch-Jozsa, Bernstein-Vazirani, and Simon's. Emphasis is placed on quantum circuit design, algorithm interpretation, and practical problem-solving skills, preparing students for advanced study and applications in quantum information processing.

Course Objectives

- Explain the evolution and historical significance of quantum computing and its basic physical principles.
- Describe the representation and manipulation of qubits, including single- and multi-qubit systems.
- Interpret the role of quantum operators and measurement processes in computation.
- Explain the principles of quantum communication protocols and key distribution techniques.
- Describe the structure and functioning of quantum circuits and algorithms, emphasizing their practical applications.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand the fundamentals of quantum computing, including superposition, entanglement, and linear algebra.	**K2**	1.7.1, 2.5.2, 2.6.3
CO2	Illustrate single and multi-qubit systems, quantum gates, and tensor products using mathematical models.	**K2**	1.7.1, 2.5.2, 2.6.3
CO3	Interpret quantum operators, measurements, and entanglement in quantum computations.	**K2**	1.7.1, 2.5.2, 2.6.3, 5.4.1
CO4	Apply quantum gates and protocols to design circuits and implement quantum key distribution.	**K3**	1.7.1, 2.5.2, 2.6.3
CO5	Construct and analyze quantum circuits and implement algorithms like Grover's and Deutsch-Jozsa.	**K3**	1.7.1, 2.5.2, 2.6.3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2													
CO2	1	2	1										1	2
CO3	1	2	2		1								2	1
CO4	1	2	2										1	1
CO5	1	2	2										1	1

Course Content

Unit – I : Foundations of Quantum Computing and Quantum Physics

Introduction and History: Brief History of Quantum Computing: Early Developments and Algorithms, Shor and Grover, Defining a Quantum Computer
Fundamentals of Quantum Physics: Superposition and Entanglement, The Born Rule, Schrödinger's Equation, The Physics of Computation. Spin and Measurement Basics: The Quantum Clock, Measurements in the Same Direction, Measurements in Different Directions, Measurements, Randomness, Photons and Polarization
Linear Algebra Foundations: Complex Numbers versus Real Numbers, Vectors, Diagrams of Vectors, Lengths of Vectors, Scalar Multiplication, Vector Addition, Orthogonal Vectors, Multiplying a Bra by a Ket, Bra-Kets and Lengths, Bra-Kets and Orthogonality, Orthonormal Bases, Vectors as Linear Combinations of Basis Vectors, Ordered Bases, Length of Vectors, Matrices

Unit – II: Qubits, Single-Qubit, and Multi-Qubit Systems

Qubits and Single-Qubit Systems: Introducing Quantum Bits, Bras and Kets, The Complex Math and Physics of a Single Qubit, A Nonlinear Projection, The Bloch Sphere, Gates and Unitary Matrices, Probability, Mathematics of Quantum Spin, Equivalent State Vectors, The Basis Associated with a Given Spin Direction, Rotating the Apparatus through 60°.
The Mathematical Model for Photon Polarization, The Basis Associated with a Given Polarization Direction, The Polarized Filters Experiments, Qubits, Alice, Bob, and Eve, Probability Amplitudes and Interference
Multi-Qubit Systems: Two Qubits, Three, Tensor Products, Entanglement, Multi-Qubit Gates

Unit – III: Quantum Operators, Measurement, and Entanglement

Qubits, Operators, and Measurement: Quantum Operators, Unary Operators, Binary Operators, Ternary Operators, Comparison with Classical Gates, Universality of Quantum Operators, Gottesman-Knill and Solovay-Kitaev, The Bloch Sphere, The Measurement Postulate, Computation-in-Place
Entanglement: Alice and Bob's Qubits Are Not Entangled, Unentangled Qubits Calculation, Entangled Qubits Calculation, Superluminal Communication, The Standard Basis for Tensor Products, Process of Entangling Qubits, Using the CNOT Gate to Entangle Qubits, Entangled Quantum Clocks

Unit – IV : Quantum Gates, Circuits, and Key Distribution

Bell's Inequality and Quantum Key Distribution: Entangled Qubits in Different Bases, Einstein and Local Realism, Einstein and Hidden Variables, A Classical Explanation of Entanglement, Bell's Inequality, The Answer of Quantum Mechanics, The Classical Answer, Measurement, The Ekert Protocol for Quantum Key Distribution
Quantum Gates and Circuits: Qubits, The CNOT Gate, Quantum Gates, Quantum Gates Acting on One Qubit, Universal Quantum Gates, No Cloning Theorem, Quantum Computation versus Classical Computation, The Bell Circuit, Superdense Coding, Quantum Teleportation, Error Correction

Unit – V: Quantum Circuits and Quantum Algorithms

Quantum Circuits: From Gates to Circuits: Constructing a Circuit, Building Blocks and Universality: The Toffoli Gate, Making NAND Reversible, Building More Complicated Circuits, Copying a Qubit, Teleportation, Amplitude Amplification and Interference: Flipping the Sign, Inversion about the Mean, Interference, Maximizing the Amplitude, Searching with Grover: Grover's Search Algorithm, Using the Oracle, Understanding the Oracle, The Data Problem.
The Deutsch-Jozsa Algorithm: More Hadamard Math, Another Oracle Circuit, The Bernstein-Vazirani Algorithm: The Problem, The Circuit, Simon's Algorithm: The Problem, The Circuit, Analysis of the Circuit Results

Text Books

1. C. Bernhardt, Quantum Computing for Everyone. Cambridge, MA: The MIT Press, 2019.
2. J. D. Hidary, Quantum Computing: An Applied Approach, 2nd ed. Cham, Switzerland: Springer, 2021.

Reference Books

1. P. Kaye, R. Laflamme, and M. Mosca, An Introduction to Quantum Computing, Cambridge University Press, 2007.
2. E. Rieffel and W. Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. N. David Mermin, Quantum Computer Science: An Introduction, Cambridge University Press, 2007.

Web Resources

- IBM Quantum, "IBM Quantum Documentation," IBM, [Online]. Available:`https://quantum-//computing.ibm.com/docs/`. [Accessed: May 28, 2025].
- Microsoft, "Quantum Development Kit Documentation," Microsoft Learn, [Online]. Available: `https://learn.microsoft.com/en-us/azure/quantum/`. [Accessed: May 28, 2025].
- Quantum Algorithm Zoo, "Quantum Algorithm Zoo – A collection of known quantum algorithms," National Institute of Standards and Technology (NIST), [Online]. Available:`https://quantumalgorithmzoo.org/`. [Accessed: May 28, 2025].

HONORS

DIGITAL FORENSICS AND CYBER SECURITY

COURSE CODE: 24OE521A
Foundations of Cybersecurity and Digital Crime Investigation

Course Category:	Honors	**Credits:**	4
Course Type:	Theory	**Lecture -Tutorial-Practice:**	4-0-0
Pre-requisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course provides the theoretical foundations of cybersecurity and digital crime investigation. It covers security principles, cyber threats, vulnerabilities, forensic methodologies, evidence principles, security policies, and legal/ethical frameworks. Students gain conceptual knowledge of disk, memory, network, and mobile forensics and incident response processes. Tools and technologies used in the industry are introduced.

Course Objectives

- To understand the fundamental principles of cybersecurity, including threats, vulnerabilities, and risk management concepts.
- To understand the processes and methodologies used in digital forensic investigations and evidence handling.
- To understand the theoretical foundations of disk, memory, network, and mobile forensics.
- To apply security and forensic concepts to interpret incident response procedures and organizational security policies.
- To analyze the legal, ethical, and regulatory frameworks governing cybercrime and digital evidence.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand fundamental cybersecurity principles, threat categories, attack vectors, and system vulnerabilities.	**K2**	1.2.2, 1.7.1
CO2	Understand the stages of the digital forensic process and the requirements for evidence acquisition, preservation, and chain of custody.	**K2**	1.2.2, 1.7.1, 4.4.3, 4.5.1, 7.3.2
CO3	Understand theoretical concepts of disk, memory, network, and mobile forensics to interpret digital artefacts in investigative scenarios.	**K2**	1.2.2, 1.7.1, 4.4.3, 4.6.1, 4.6.2, 5.4.1
CO4	Apply incident response procedures, organizational security controls, and investigative workflows to assess their effectiveness.	**K3**	1.2.2, 1.7.1, 2.7.1, 2.7.2, 3.7.1, 4.6.1
CO5	Analyze legal, ethical, and regulatory considerations relevant to cybercrime investigations and digital evidence handling.	**K4**	1.7.1, 7.3.2

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2											1	3
CO2	2			3					3					3
CO3	2			3	3								1	3
CO4	1	3	2	3										3
CO5	3						3							2

Course Content

Unit – I : Introduction to Cyber Security and Digital Crime

Foundations of Cybersecurity: Security goals, Core security principles, Security mechanisms
Cybersecurity Landscape: Evolution and importance of cybersecurity, Types of systems and assets at risk: networks, endpoints, cloud, IoT, Security policies, standards, and best practices
Digital Crime Fundamentals: Definition and classification of digital crimes. Cybercrime ecosystem, Actors: hackers, cybercriminal groups, insiders, state-sponsored adversaries, Motives: financial, espionage, activism, personal revenge
Common Digital Crimes: Malware and ransomware, Phishing and social engineering, Identity theft and financial fraud, Cyberstalking, Cyberbullying, Data breaches and privacy violations

Unit – II: Cyber Threats, Vulnerabilities & Attack Techniques

Vulnerabilities: Software vulnerabilities, Misconfigurations, Design flaws
Threats & Threat Actors: Classification, APTs (Advanced Persistent Threats), Insider threats
Attack Vectors: Network-based attacks, Web attacks, System attacks, Cloud security threats
Malware & Exploits: Virus, worm, trojan, ransomware, keyloggers, Exploit kits, payloads, backdoors, Threat intelligence basics

Unit – III: Digital Forensics Fundamentals

Overview of Digital Forensics: Definition, scope, and need, Role of digital forensics in cybersecurity and law enforcement, Types of digital forensics
Forensic Process Model: Preparation and planning, Identification of sources, Evidence acquisition approaches, Chain of custody, Evidence preservation, Analysis & correlation, Reporting principles.
Memory & Network Artefacts: Volatile memory contents, Packet traces, flow records, IDS/IPS logs, Artefact correlation in investigations

Unit – IV : Incident Response & Security Controls

Incident Response (IR) Lifecycle: NIST Incident Response Framework, Phases
Detection and Analysis: Indicators of compromise (IoCs), Indicators of attack (IoAs), Log analysis principles, Threat modeling basics
Organizational Security Controls: Administrative controls, Technical controls, Physical controls
Security Architecture Concepts: Defence-in-Depth, Zero Trust Architecture, Identity and Access Management (IAM), Network segmentation, micro-segmentation

Unit – V: Legal, Ethical, and Regulatory Aspects of Cybercrime

Cybercrime Laws & National Legal Framework: Indian IT Act 2000 & Amendments, Evidence Act (Digital Evidence Provisions); Cyber Appellate Tribunal; CERT-In mandates and advisory structures
International Laws & Frameworks: GDPR basics (data protection and privacy), Budapest Convention on Cybercrime, International cooperation in cyber investigations
Ethical Considerations: Ethics in handling digital evidence, Professional responsibilities of cybersecurity analysts, Ethical hacking vs. illegal intrusion, Privacy vs. surveillance
Regulatory and Compliance Requirements: ISO 27001 overview, PCI-DSS, HIPAA, SOX basics (relevance & context), Organizational policy and compliance obligations
Documentation & Reporting: Forensic reporting structure, Expert testimony basics, Maintaining admissibility of digital evidence

Text Books

1. W. Stallings and L. Brown, Computer Security: Principles and Practice, 4th ed. Pearson, 2018.
2. B. Nelson, A. Phillips, and C. Steuart, Guide to Computer Forensics and Investigations, 6th ed. Cengage Learning, 2018.
3. J. Luttgens, M. Pepe, and K. Mandia, Incident Response & Computer Forensics, 3rd ed. McGraw-Hill Education, 2014.

Reference Books

1. C. Brooks, J. Grow, and P. Craig, Cybersecurity Essentials. Wiley, 2018.
2. E. Casey, Digital Forensics: Theoretical Principles and Practice, 2nd ed. Academic Press, 2011.
3. J. Luttgens, M. Pepe, and K. Mandia, Incident Response & Computer Forensics, 3rd ed. McGraw-Hill Education, 2014.
4. B. Carrier, File System Forensic Analysis. Addison-Wesley Professional, 2005.
5. National Institute of Standards and Technology, NIST Special Publications (SP 800 Series): Digital Forensics and Incident Response Guidelines. U.S. Department of Commerce, 2014–present.

Web Resources

1. **NPTEL**, "Cyber Security and Privacy," [Online]. Available: `https://onlinecourses.nptel.ac.in/noc23cs127/preview`. [Accessed: Nov. 28, 2025].
2. **SWAYAM**, "Digital Forensic," [Online]. Available: `https://onlinecourses.swayam2.ac.in/cec20lb06/preview`. [Accessed: Oct. 22, 2025].

3. **SWAYAM**, "Information Security and Cyber Forensics," [Online]. Available:https://onlinecourses.swayam2.ac.in/cec21ge10/preview. [Accessed: Nov. 25, 2025].

4. **National Institute of Standards and Technology (NIST)**, "NIST Cybersecurity Framework Documentation," [Online]. Available: https://www.nist.gov/cyberframework. [Accessed: Oct. 30, 2025].

5. **SANS Institute**, "SANS Reading Room: Cybersecurity and Digital Forensics Whitepapers," [Online]. Available:https://www.sans.org/white-papers. [Accessed: Nov. 21, 2025].

6. **CERT-In**, "Advisories and Vulnerability Notes," Indian Computer Emergency Response Team, [Online].Available:https://www.cert-in.org.in/. [Accessed: Oct. 18, 2025].

7. **OWASP Foundation**, "OWASP Top 10: The Ten Most Critical Web Application Security Risks," [Online]. Available: https://owasp.org/www-project-top-ten/. [Accessed: Nov. 19, 2025].

8. Europol, "Cybercrime Reports and Threat Assessments," [Online]. Available: https://www.europol.europa.eu/. [Accessed: Oct. 27, 2025].