



Semester – I

Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621 220

MASTER OF COMPUTER APPLICATIONS (M.C.A)

CHOICE BASED CREDIT SYSTEM – LEARNING OUTCOMES BASED

CURRICULUM FRAMEWORK (CBCS- LOCF)

(For the candidates admitted from the Academic Year 2025 - 26 onwards)



Semester	Course Code	Title of the Course	Ins. Hours /Week	Credits	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)	
I	25PCA1CC1	Mathematical Foundations of Computer Applications	6	5	3	25	75	100	
	25PCA1CC2	Cloud Computing Fundamentals	6	5	3	25	75	100	
	25PCA1CP1	Practical: Cloud Computing Lab	3	2	3	40	60	100	
	25PCA1CC1A/ 25PCA1CC1B/ 25PCA1CC1C	Open Source Programming/ Advanced Java Programming / Internet of Things	6	4	3	25	75	100	
	25PCA1CC1AP/ 25PCA1CC1BP/ 25PCA1CC1CP	Practical: Open Source Programming / Practical: Advanced Java ProgrammingLab/ Practical: Internet of Things Lab	3	2	3	40	60	100	
	25PCA1EC1A/ 25PCA1EC1B/ 25PCA1EC1C/ 25PCA1EC1D	Data Security and Privacy/ Cloud Management/ Artificial Intelligence for Network Security/ Virtual Reality and Augmented Reality	6	4	3	25	75	100	
	25PCA1VAC1	Hardware and Networking Essentials (Value Added Course 1)	0	2*	3	50	50	100*	
	Total			30	22		-	-	600
	MANDATORY BRIDGE COURSE FOR STUDENTS OF NON-COMPUTER SCIENCE STREAM 1st SEMESTER								
		25PCA1BC1	Programming in C and C++		4	3	25	75	100
		25PCA1BC2	Fundamental of Data Structures		4	3	25	75	100
		25PCA1BCP1	Practical: Programming in C and C++		2	3	40	60	100
	Total				32		-	-	900

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE /SE/GS / EVS/VE/ VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1CC1	5	Mathematical Foundations Of Computer Applications	CC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of mathematics at the higher secondary level, familiarity with algebraic operations, and basic programming logic. 											
Course Objectives: The purpose of learning this course is:											
1. Understand the principles of propositional and predicate logic.											
2. Learn the foundational concepts of sets, relations, and orderings.											
3. Gain knowledge of group theory and its basic structures.											
4. Develop understanding of graph concepts and tree structures.											
5. Learn the basics of formal languages, grammars, and automata.											
Course Outcomes:											
CO1: Formulate and evaluate logical statements using truth tables and well-formed formulas.											
CO2: Apply set operations, relations, and ordering properties to solve problems.											
CO3: Identify and verify group properties, subgroups, and normal subgroups.											
CO4: Represent and analyze graphs and trees using matrix and diagrammatic methods.											
CO5: Design and interpret regular expressions, grammars, and finite automata.											
Unit - I	MATHEMATICAL LOGIC									15 Hrs.	
Statements and notation – Connectives – Negation – Conjunction – Disjunction – Statement formulae and truth tables – Conditional and BiConditional - Well formed formulas – Tautologies – Equivalences of formula – Duality Law. Predicate Calculus: Predicates – Statement functions – variables – Quantifiers – predate formulae – free & bound variables.											
Unit - II	BASIC CONCEPTS OF SET THEORY									15 Hrs.	
Notation – Inclusion of equality of sets – power set – operation on sets – Venn diagrams – Cartesian products. Relations and Ordering: Relations – Properties of Binary relation in a set – Relation matrix and graph – Equivalence relations – Composition of binary relations – Partial Ordering.											
Unit - III	GROUPS									15 Hrs.	
Definition and examples – Sub groups – Homomorphism – Cosets – Normal Subgroups											
Unit - IV	GRAPH THEORY									15 Hrs.	
Basic Definitions – Paths, Reachability Connectedness – Matrix Representation of graphs – Trees.											
Unit - V	GRAMMARS AND LANGUAGES									15 Hrs.	
Introduction – alphabet, words, languages – regular expressions, regular languages - Finite state Automata – Grammars – Gödel Numbers.											

Text Book(s):

1. Lipschutz Seymour, Lipson Marc, “Discrete Mathematics”, Schaum’s Outline Series, Tata McGraw Hill, New Delhi, 2007.(UNIT-I)
2. Tremblay J.P., Manohar R., “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw Hill, New Delhi, 1997.(UNIT-II)
3. Kolman Bernard, Busby Robert C., Ross Sharon Cutler, “Discrete Mathematical Structures for Computer Science”, 2nd Edition, PHI, 2014.(UNIT-III)
4. Levin Oscar, “Discrete Mathematics: An Open Introduction”, Third Edition, 2013.(UNIT-IV)
5. Hopcroft John E., Ullman Jeffrey D., “Introduction to Automata Theory, Languages and Computation”, Narosa Publishing House, New Delhi, 2014.(UNIT-V)

Reference Book(s):

1. Kenneth H. Rosen “Discrete Mathematics and Its Applications 8th Edition, McGraw-Hill Education, 2018 ISBN: 978-1259676512
2. Richard Johnsonbaugh “Discrete Mathematics 8th Edition, Pearson, 2017 ISBN: 978-4448283..
3. Susanna S. Epp “Discrete Mathematics with Applications 5th Edition, Cengage Learning, 2018 ISBN: 978-1337694363
4. Martin Erickson “Introduction to Combinatorics 2020 (Latest Edition), CRC Press ISBN: 978-0367570809
5. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman “Introduction to Automata Theory, Languages, and Computation”, 3rd Edition, Pearson, 2006 (Reprint 2019) ISBN: 978-0136016716.

Web Resources:

1. www.maths.ed.ac.uk/~aar/papers/knuthore.pdf
2. <http://infolab.stanford.edu/~ullman/focs.html>
3. <http://nptel.ac.in/courses.php?disciplineId=111>
4. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
5. <http://ocw.mit.edu/courses/mathematics/>

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1CC2	5	Cloud Computing Fundamentals	CC	5	1	-	3 Hrs.	25	75	100

Pre-Requisite:

- Basic knowledge of computing concepts and types of computing
- Understanding of networking, storage, and virtualization fundamentals

Course Objectives: The purpose of learning this course is:

1. To provide content aligned with challenging industrial standards and relevant technical knowledge and skills, enabling students to further their education and succeed in emerging as professionals.
2. Communicate effectively for a range of purposes and audiences.
3. Describe the benefits of cloud computing and the reasons companies have started to switch from on premise computing to cloud computing
4. Developing students' skills for implementing cloud solutions in various scenarios.
5. Students to pursue continuous professional development to enhance career growth and industry relevance.

Course Outcomes:

CO1: Differentiate the different computing approaches and their characteristics.

CO2: Develop cloud usage plans for a business case study, and describe how each of the four services can be used to improve the business.

CO3: Integrate cloud models and technologies to design and implement cloud computing architectures.

CO4: Employ cloud service models and technologies for application development and deployment.

CO5: Explore cloud computing services, applications, tools, and use cases

Unit - I | **Types of Computing** | **15 Hrs.**

Overview and Characteristics of: Parallel Computing – Distributed Computing – Cluster Computing – Grid Computing – Mobile Computing – Quantum Computing – Nano Computing – Cloud Computing – Evolution of Cloud Computing

Unit - II | **Introduction of Cloud Computing and Cloud Models** | **15 Hrs.**

Motivation for Cloud Computing – Defining Cloud Computing – Principles of Cloud Computing – Private Cloud – Public Cloud – Community Cloud – Hybrid Cloud – Infrastructure as a Service – Platform as a Service – Software as Service.

Unit - III | **Cloud Technologies** | **15 Hrs.**

SOA and Cloud – Network Technologies – Web 2.0 – Web 3.0 – Software Process Models for Cloud – Agile SDLC for Cloud – Programming Models – Pervasive Computing – Operating Systems – Application Environment – Virtualization]

Unit - IV | **Intelligent Cloud Applications** | **15 Hrs.**

Cloud Architecture – Network Connectivity in Cloud Computing – Managing the Cloud - Machine Learning and Deep Learning Models in Cloud – Functions-as-a-Service and Event-Driven Programming – Serverless Application Programming Interfaces in Microsoft Azure – Microsoft Azure Functions – Machine Learning and Deep Learning Models – Deployment and Scaling – Monitoring

Unit - V | **Cloud Service Providers and Cloud Open source Tools** | **15 Hrs.**

EMC – Google – Amazon Web Services – Microsoft – IBM – SAP Labs – Salesforce – Vmware – Open Source Tools for IaaS – Open Source Tools for PaaS - Open Source Tools for SaaS

Text Book(s):

1. Dr.Vimal Mishra, Dr. A K Dubey, Aditya Bhushan, SK Singh, “Mastering Cloud Computing”, Independently Published, 2024, ISBN 13: 979-8882864438 (UNIT –I)(UNIT-V)
2. Judith Hurwitz, Marica Kaufman, Dr Fern Halper, “ Cloud Services for Dummies’, IBM Limited Edition, John Wiley & Sons, 2012, SIBN: 978-1-118-33891-9 (UNIT-II)
3. K. Chandrasekaran, “Essentials of Cloud Computing”, CRC Press, 2025, ISBN 13: 978-1-4822-0544-2
4. (UNIT-III)
5. De John Biggs, Vicente Herrera Garcia, “ Building Intelligent Cloud Applications: Develop Scalable Models using Serveless Architectures with Azure”, 1st edition, O’Reilley Media, 2019, ISBN: 978-1-492-05232-6(UNIT-IV).

Reference Book(s):

1. Cloud Computing Demystified: A Comprehensive Guide Elena Sterling, Packt Publishing, April 2024Simplifies cloud concepts & real-world applications—ideal for beginners and practitioners Analytics Insight.
2. Edge Computing with Amazon Web Services Sean Howard, Packt Publishing, February 2024
3. Focuses on AWS edge-cloud architecture and real-time processing—great for modern infrastructure design Analytics Insight.
4. Cloud Computing for Dummies (2nd Edition) Judith Hurwitz & Daniel Kirsch, John Wiley & Sons, August 2020 (2nd ed.)
5. Cloud Computing Basics: A Non-Technical Introduction Anders Lisdorf, APress, March 2021Beginner-oriented overview of cloud architecture.

Web Resources:

1. <https://aws.amazon.com>
2. <https://azure.microsoft.com>
3. <https://cloud.google.com>
4. <https://nptel.ac.in/courses/106105167>
5. <https://cloudcomputing.ieee.org>

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		3 Hrs.	CIA	ESE
I	25PCA1CC3P	2	Cloud Computing Lab	CC	-	-	3	3 Hrs.	40	60	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of Operating Systems and Computer Networks. Familiarity with programming in C/Java/Python. Fundamentals of cloud computing concepts. 											
Course Objectives: The purpose of learning this course is:											
1. Understand virtualization concepts and setup using VirtualBox/VMware.											
2. Learn compiler installation and execution of basic programs in VMs.											
3. Gain practical exposure to Google App Engine and simple web app deployment.											
4. Explore cloud simulation using CloudSim and implement custom scheduling.											
5. Learn file transfer, VM launch, and Hadoop single-node setup for cloud applications.											
Course Outcomes:											
CO1: Ability to create and manage virtual machines.											
CO2: Install and use compilers to execute simple programs.											
CO3: Develop and deploy web apps on Google App Engine.											
CO4: Simulate and analyze cloud scenarios using Cloud Sim.											
CO5: Implement Hadoop applications in a single-node cluster.											
List of Practicals									Hrs.45		
1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.											
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.											
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.											
4. Use GAE launcher to launch the web applications.											
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.											
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.											
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)											
8. Install Hadoop single node cluster and run simple applications like wordcount.											

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					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1CC1A	4	Open Source Programming	CCC	5	1	-	3 Hrs.	25	75	100

Pre-Requisite:

- Basic knowledge of web development concepts (HTML, CSS, JavaScript).
- Fundamental understanding of databases and SQL.

Course Objectives: The purpose of learning this course is:

1. Understand open-source licensing principles, copyright laws, and free software development models.
2. Learn PHP syntax, variables, control structures, and data handling.
3. Gain skills in advanced PHP features, OOP concepts, and error handling mechanisms.
4. Integrate PHP with MySQL for dynamic database-driven applications.
5. Use AJAX for dynamic web content and GitHub for collaborative development.

Course Outcomes:

- CO1:** Identify and apply appropriate open-source licenses and evaluate their legal implications.
- CO2:** Develop basic PHP programs using variables, arrays, and functions to handle dynamic data.
- CO3:** Implement object-oriented PHP applications with session handling, file operations, and exception management.
- CO4:** Design and implement database operations in PHP using MySQL queries and forms.
- CO5:** Build interactive web applications using PHP and AJAX, and manage projects on GitHub.

Unit - I | OPEN SOURCE & FREE SOFTWARE LICENSING | 15 Hrs.

Open Source Licensing: Basic Principles of Copyright Law – Contract and Copyright – Open Source Software Licensing – Issues with Copyrights and Patents – Open Source Definition – MIT License – BSD License – Apache License – GNU General Public License – Free and Open Source Software Development: Models of Open Source and Free Software Development – Choosing an Open Source or Free Software License

Unit - II | BASICS OF PHP PROGRAMMING | 15 Hrs.

Basics of PHP Programming: Introduction – syntax and variables – controls and functions – passing information between pages – strings – numbers – arrays, array functions and advanced array functions

Unit - III | ADVANCED FEATURES AND TECHNIQUES | 15 Hrs.

Advanced PHP Programming: Object-Oriented Programming with PHP – String and Regular Expression Functions – Filesystem and System Functions – Sessions, Cookies and HTTP – Exceptions and Error Handling

Unit - IV | PHP AND MySQL | 15 Hrs.

Why PHP and MySQL? – Server-Side Web Scripting – SQL Tutorial – MySQL Database Administration – PHP/MySQL Functions – Displaying Queries in Tables – Building Forms from Queries

Unit - V | PHP & AJAX AND GITHUB HOSTING SERVICE | 15 Hrs.

PHP and AJAX: JavaScript and AJAX Client – JavaScript and DOM – XML Http Request Object – AJAX form validation – Uploading a file using AJAX – Displaying a table in AJAX – Building Pagination using PHP and AJAX Hosting Open Source Projects using Github: Introduction – Viewing Github Graphs- Editing Files – Collaborating on Pull Requests – Creating a Repository – Configuring a Repository.

Text Book(s):

1. Andrew M. St. Laurent, “Understanding Open Source & Free Software Licensing”, O’Reilly Media, 2004. (UNIT_I)
2. Tim Converse and Joyce Park, “PHP 5 and MySQL Bible”, Wiley Publishing, 2004.(UNIT-II) (UNIT-III) (UNIT-IV)
3. K.Meena, R.Slvakumar,A .B.Karthick Anand Babu, “Web Programming with PHP and Mysql”, Himalaya Publications. Mumbai, 2012. (UNIT-II) (UNIT-III)
4. Peter Bell and Brent Beer, ”Introducing Github: a Non-Technical Guide”, O’Reilly Media, 2014 Gordon Haff, “How Open Source Ate Software”, Apress, 2018. Rao M. N., ‘Fundamentals of Open Source Software’, PHI Learning Pvt Ltd, 2014 .(UNIT-V).

Reference Book(s):

1. Robin Nixon “Learning PHP, MySQL & JavaScript with jQuery, CSS & HTML5 O’Reilly Media, 5th Edition, 2018 ISBN: 978-1491918661.
2. Matt Zandstra “PHP Objects, Patterns, and Practice 5th Edition, Apress, 2019 ISBN: 978-1484240319.
3. Chris Pitt “Modern PHP: New Features and Good Practices 2nd Edition, O’Reilly Media, 2017 ISBN: 978-1491905012.
4. Josh Lockhart “ Modern PHP: New Features and Good Practices”, O’Reilly Media,2018, 978-1-491-91881-1.
5. Mika Schwartz & M. Zandstra “ PHP Objects, Patterns, and Practice”, Apress,2021, 978-1-4842-6890-7

Web Resources:

1. https://swayam.gov.in/nd2_aic20_sp32/
2. https://www.tutorialspoint.com/php/php_and_mysql.htm
3. <https://docs.github.com/en/get-started/quickstart/hello-world>
4. https://developer.mozilla.org/en-US/docs/Web/Guide/AJAX/Getting_Started.
5. <https://www.w3schools.com/php/>

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Sem.	Course Code	Credits	Title of the Course	CC / AC/ DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1CC1B	4	Advanced Java Programming	CCC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Knowledge of basic C Programming concepts, object-oriented principles, HTML basics, and database fundamentals. 											
Course Objectives: The purpose of learning this course is:											
1. Understand core Java concepts including data types, control structures, OOP principles, and multithreading.											
2. Learn generic programming and Java Collection Framework.											
3. Gain skills in building GUI applications using JFC/Swing components.											
4. Understand server-side programming using Java Servlets and JSP.											
5. Learn EJB architecture and its role in distributed applications.											
Course Outcomes:											
CO1: Develop Java programs using classes, inheritance, packages, exception handling, and threads.											
CO2: Implement type-safe generic methods and use sets, queues, lists, and maps effectively.											
CO3: Design and implement interactive GUI applications with event handling and layout management.											
CO4: Develop dynamic web applications with session tracking, database connectivity, and JSP integration.											
CO5: Design, implement, and deploy EJB-based enterprise applications.											
Unit - I	Understanding Java and Platform								15 Hrs.		
Genesis of Java- Types of Java applications – Data types, variables and arrays – Operators – Utility Classes – String Handling- Control statements – Classes and Methods – Inheritance – Packages and Interfaces –Exception Handling- Multithreaded Programming.											
Unit - II	Java Generics and Collections Framework"								15 Hrs.		
Generics - boxing and unboxing - for each generic's methods and variable arguments- sub typing and wildcards - data declaration – collection interfaces - sets – queue - lists- maps											
Unit - III	JAVA AWT Events								15 Hrs.		
Java Foundation classes (JFC) /Swings –JButtons, JLabels, JCheck boxes, JRadio Buttons, JChoices, Lists, JText Fields and JText areas – JScrollbars – Canvases – Event Delegation model – Exceptions – Event classes – Listener Interfaces – Containers and Layout Managers– Adding tool tips and icons – Popup menus – Tabbed panes – sliders –progress bars – Tables.											
Unit - IV	The JAVA Library								15 Hrs.		
Servlet basics-the servlet life cycle- retrieving information- sending HTML information- the session tracking-database connectivity. JSP: Introducing Java server pages – basics- beneath JSP -JSP session - JSP architecture – security.											
Unit - V	JAVA Beans								15 Hrs.		
EJB architecture- EJB requirements – design and implementation – EJB session beans- EJB entity beans-EJB Clients – deployment tips, tricks and traps for building distributed and other systems – implementation and future directions of EJB											

Text Book(s):

1. J. McGovern, R. Adata, Y. Fain, "J2EE 1.4 Bible", Wiley- Dream Tech India Pvt. Ltd, New Delhi, 2003. (UNIT-I) (UNIT-II)
2. H. Schildt, "Java 2 Complete Reference", Fifth Edition, Tata McGraw-Hill, New Delhi, 2002. (UNIT-III)(UNIT-IV)
3. Sierra Kathy, "Head First Java", Second Edition, O'Reilly Media, 2005 Holzner Steve, Holzner Steven, Java 2 Black Book, Second Edition, Paraglyph Press, 2002.(UNIT-V)

Reference Book(s):

1. Herbert Schildt "Java: The Complete Reference "11th Edition, McGraw-Hill Education, 2018
2. ISBN: 978-1260440232
3. Kathy Sierra & Bert Bates "Head First Java 3rd Edition, O'Reilly Media, 2023 ISBN: 978-1492178066.
4. Josh Juneau "Core Java Volume I—Fundamentals 12th Edition, Pearson, 2023, ISBN: 978-0135166307
5. Effective Java by Joshua Bloch (3rd Edition) Java Concurrency in Practice by Brian Goet

Web Resources:

1. <https://www.edureka.co/blog/advanced-java-tutorial>
2. <https://www.khanacademy.org/computing/computer-programming>
3. <https://www.javatpoint.com/ejb-tutorial>
4. <https://docs.oracle.com/javase/tutorial/uiswing/start/about.html>
5. <https://www.w3schools.com/php/>

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Sem.	Course Code	Credits	Title of the Course	CC / AC/ DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1CC1C	4	Internet of Things	CCC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of Computer Networks and Programming. 											
Course Objectives: The purpose of learning this course is:											
1. To introduce the fundamentals, physical and logical design of IoT.											
2. To understand IoT architecture, models, and reference frameworks.											
3. To explore IoT communication protocols and standards.											
4. To study Web of Things and Cloud of Things concepts.											
5. To analyze IoT applications in real-world domains.											
Course Outcomes:											
CO1: Explain IoT concepts, design principles, and enabling technologies.											
CO2: Interpret IoT architectures and reference models.											
CO3: Apply IoT protocols and standards in communication networks.											
CO4: Utilize WoT and CoT platforms for IoT solutions.											
CO5: Demonstrate IoT applications in smart environments.											
Unit - I	INTRODUCTION OF IoT								15 Hrs.		
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels and Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.											
Unit - II	IoT ARCHITECTURE								15 Hrs.		
M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model- functional model - communication model - IoT reference architecture											
Unit - III	IoT PROTOCOLS								15 Hrs.		
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols –IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer– 6LowPAN - CoAP - Security											
Unit - IV	WEB OF THINGS								15 Hrs.		
Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT – Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.											
Unit - V	APPLICATIONS								15 Hrs.		
The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments - Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents. Applications- Smart Grid – Electrical Vehicle Charging.											

Text Book(s):

1. Arshdeep Bahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015. [unit -I] [unit -III] [unit -V]
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011. [unit -II]
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis ,Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014. [unit -II] [unit -IV]
4. Networks, Crowds, and Markets: Reasoning About a Highly Connected World -David Easley and Jon Kleinberg, Cambridge University Press - 2010.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things –Key applications and Protocols”, Wiley, 2012. [unit -III] [unit -IV]

Reference Book(s):

1. Sudip Misra, Anandajit Goswami, “Introduction to Internet of Things”, 1st Edition, Cambridge University Press, 2021, ISBN: 9781108836032.
2. Rajkumar Buyya, Amir Vahid Dastjerdi, “Internet of Things: Principles and Paradigms”, 2nd Edition, Elsevier/Morgan Kaufmann, 2020, ISBN: 9780128196646.
3. Rajiv Chopra, “Internet of Things: Architecture, Implementation, and Security”, 1st Edition, McGraw Hill, 2022, ISBN: 9789354600479.
4. Dominique Guinard, Vlad Trifa, “Building the Web of Things: With Examples in Node.js and Raspberry Pi”, 1st Edition, Manning Publications, 2016, ISBN: 9781617292682.
5. Rajkumar Buyya, Satish Narayana Srirama, “Fog and Edge Computing: Principles and Paradigms”, 1st Edition, Wiley, 2019, ISBN: 9781119551713.

Web Resources:

1. <https://www.javatpoint.com/iot-internet-of-things>
2. <https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/>
3. <https://www.edureka.co/blog/iot-tutorial/>

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1CC1AP	2	Open Source Programming Lab	CCP	-	-	3	3 Hrs.	40	60	100

Pre-Requisite:

- Knowledge of Open source
- Programming concepts HTML, Mysqli

Course Objectives: The purpose of learning this course is:

1. Understand the fundamentals of server-side scripting (PHP) and database connectivity (MySQL).
2. Apply HTML forms with PHP scripts to design interactive and dynamic web pages.
3. Develop applications using PHP concepts such as sessions, file handling, and object-oriented programming.
4. Integrate PHP with MySQL for creating, reading, updating, and deleting data.
5. Explore shell scripting for automation of tasks in operating systems.

Course Outcomes:

CO1: Create dynamic web pages using PHP and HTML forms.

CO2: Implement shopping cart, file upload, and session management.

CO3: Design and manipulate MySQL databases and tables with PHP.

CO4: Execute shell scripts for file and system operations.

CO5: Integrate PHP, MySQL, and shell programming to solve application problems.

List of Practical

45 Hrs.

1. Write a server side PHP program that displays marks, total, grade of a student in tabular format by Accepting user inputs for name, number and marks from a HTML form.
2. Write a PHP program that adds products that are selected from a web pageto a shopping cart.
3. Write a PHP program to access the data stored in a mysql table.
4. Write a PHP program interface to create a database and to insert a tableinto it.
 - i) Write a PHP program using classes to create a table.
 - ii) Write a PHP program to upload a file to the server.
5. Write a PHP program to create a directory, and to read contents from the directory.
6. Write a shell program to find the details of an user session.
7. Write a shell program to change the extension of a given file.
8. Create a mysql table and execute queries to read, add, remove and modify a Recordfrom that table.

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1CC1BP	2	Advanced Java Programming Lab	CCP	-	-	3	3 Hrs.	40	60	100

Pre-Requisite:

- Basic knowledge of Java programming (variables, control structures, OOP concepts).
- Understanding of HTML basics for web-related programs.
- Basic concepts of database systems and SQL queries.

Course Objectives: The purpose of learning this course is:

1. Introduce GUI application development using Java Swing.
2. Enable database connectivity and metadata retrieval using JDBC.
3. Develop client–server applications using TCP and UDP protocols.
4. Demonstrate web application development using Servlets.
5. Apply problem-solving techniques to create interactive and functional applications.

Course Outcomes:

CO1: Design interactive GUIs using Java Swing components.

CO2.: Connect Java applications to databases and handle metadata with JDBC.

CO3: Implement TCP and UDP communication for network-based applications.

CO4: Create and manage web-based applications using Servlets and cookies.

CO5: Build multi-page, stateful applications with user input validation and navigation control.

List of Practical

45 Hrs.

1. Develop a program to implement Calculator using Swing technology
2. Develop a program that displays two textboxes for entering students' Rollno and Name with appropriate labels and buttons.
3. Develop a Java program that makes a connection with database using JDBC and prints metadata of this connection.
4. Develop a java program for one-way TCP communication for server and client, where server will response to client with current data and time.
5. Develop a java program for two-way TCP communication for server and client. It should look like a simple chat application.
6. Develop a java program for UDP Communication where client will send name of country and server will return the capital of that country.
7. Create Servlet That Prints 'Hello World' and Today's Date.
8. Create Servlet for login page, if the username and password is correct then prints message "Hello username" else a message "login failed".
9. Create Servlet that uses cookies to store the number of times a user has visited the servlet.
10. Create a Servlet for demo of KBC game. There will be continuous two or three pages with different MCQs. Each correct answer carries Rs. 10000. At the end as per user's selection of answers total prize he won should be declared. User should not be allowed to backtrack.

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1CC1CP	2	Internet of Things Lab	CCP	-	-	3	3 Hrs.	40	60	100

Pre-Requisite:

- Basic knowledge of Computer Networks, Programming, and Database Management.

Course Objectives: The purpose of learning this course is:

1. To introduce fundamentals, design principles, and enabling technologies of IoT.
2. To understand IoT architectures, models, and frameworks.
3. To explore IoT protocols and communication standards.
4. To study Web of Things (WoT) and Cloud of Things (CoT) concepts.
5. To analyze domain-specific IoT applications in real-world environments.

Course Outcomes:

- CO1:** Explain IoT concepts, physical and logical designs, and enabling technologies.
- CO2:** Interpret IoT architectures, models, and reference frameworks.
- CO3:** Apply IoT protocols and standards in communication networks.
- CO4:** Utilize WoT and CoT platforms for developing IoT solutions.
- CO5:** Demonstrate IoT applications in smart and collaborative environments.

List of Practical

45 Hrs.

1. Turn an LED ON/OFF through a program.
2. Read temperature from a DHT11 sensor and display values.
3. Use LDR sensor to measure light levels.
4. Detect movement using PIR sensor and trigger LED/buzzer.
5. Send sensor data (temperature/humidity) to ThingSpeak.
6. Control an LED/fan from a mobile app via Wi-Fi.
7. Store sensor readings in CSV/Excel using Arduino IDE serial monitor.
8. Automatic light ON/OFF based on LDR and motion sensor.
9. Display sensor data on a simple webpage using NodeMCU.
10. Send messages between two devices using MQTT broker.

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category			
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total	
I	25PCA1EC1A	4	Data Security and Privacy	EC	5	1	-	3 Hrs.	25	75	100	
Pre-Requisite:												
<ul style="list-style-type: none"> Basic understanding of networking, information security fundamentals, and cryptographic concepts. 												
Course Objectives: The purpose of learning this course is:												
1. Understand fundamentals and concepts of data security.												
2. Learn methods and frameworks for securing data.												
3. Gain knowledge of principles and compliance in data protection.												
4. Understand anonymization and privacy regulations.												
5. Analyze real-world data breaches and their impacts.												
Course Outcomes:												
CO1: Explain key concepts, threats, and differences between data security, privacy, and cyber security.												
CO2: Apply encryption, classification, and endpoint protection techniques.												
CO3: Implement access control, privacy principles, and compliance measures.												
CO4: Apply tokenization, GDPR, CCPA, and CMMC principles.												
CO5: Evaluate causes and consequences of major data breaches.												
Unit - I									Introduction			15 Hrs.
Data Security – Benefits of Data Security – Key Concepts of Data Security – Data Security Threats – Types of Data Security Controls – Data Security Solutions – Data Security Best Practices – Data Security vs. Data Privacy – Data Security vs. Cyber Security – Data Security vs. Backup – Data Security vs. Application Security												
Unit - II									Securing Data			15 Hrs.
Data Security Frameworks and Standards – Data Classification and Sensitivity – Data Sensitivity Levels – Data Encryption and Cryptography – Secure Data Storage and Backup – Secure Data Prevention – Endpoint Data Protection – Emerging Trends in Data Security												
Unit - III									Data Protection and Data Privacy			15 Hrs.
Secure Data Transmission – Data Loss Prevention – Access Control and Identity Management –Data Protection – Principles of Data Protection – Data Protection Impact Assessments – Data Protection Officer – Data Protection by Design and Default – Data Protection Compliance – Concepts of Data Privacy – History of Data Privacy – Emerging Issues in Data Protection and Data Privacy – Future of Data Protection and Data Privacy												
Unit - IV									Data Privacy Principles			15 Hrs.
Static Data Anonymization: Multidimensional Data Structures – Complex Data Structures – Threats to Anonymized Data – Tokenization – GDPR – CCPA – CMMC												
Unit - V									Case Studies			15 Hrs.
Data Breach – Consequences of Data Breach – Capital One Data Breach – Marriott Data Breach – Yahoo Data Breach – Equifax Data Breach – Under Armour Data Breach – Myspace – Adult Friend Finder												

Text Book(s):

1. K. Hermans, “Mastering Data Security: A Comprehensive Guide to Become An Expert in Data Security” , Kindle Edition, 2023, ASIN: B0CDJR99Z8 ,(UNIT-I) (UNIT-II)
2. Sanjay Sharma, “Data Privacy and GDPR Handbook”, John Wiley & Sons, 2020, ISBN: 978-1-119-59424, (UNIT-III)(UNIT-IV)
3. NatarajVenkataramanan, AshwinShriram, “ Data Privacy Principles and Practice””, CRC Press, 2017, ISBN-13: 978-1-4987-2104-2,(UNIT-V).

Reference Book(s):

1. Ajay Gautham, “Data Privacy Laws and Data Protection: Protecting Personal Data: Understanding Data Privacy Laws and Data Protection”, Kindle Edition, 2023, ASIN: B0C4DPBRQ2.
2. Ravindra Das, “Reference Manual for Data Privacy Laws and Cyber Frameworks”, CRC Press, 2024, ISBN: 9781040152997.
3. Mark Ciampa – “Security+ Guide to Network Security Fundamentals – Cengage Learning” (Latest Edition, 2022).
4. Punit Bhatia – “Data Privacy: A Runbook for Engineers “– Packt Publishing, 2019.
5. The Complete Handbook of Data Privacy and GDPR — Anand Vemula (2024).

Web Resources:

1. <https://satoricyber.com/data-security/what-is-data-security-threats-controls-and-solutions/>.
2. <https://www.imperva.com/learn/data-security/data-security/>.
3. <https://www.fortinet.com/resources/cyberglossary/data-security>.
4. <https://www.csoonline.com/article/534628/the-biggest-data-breaches-of-the-21st-century.html>.
5. <https://sevenpillarsinstitute.org/case-study-equifax-data-breach/>.

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1EC1B	4	Cloud Management	EC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of cloud computing concepts, networking fundamentals, virtualization, and programming basics. 											
Course Objectives: The purpose of learning this course is:											
1. Understand the architecture of cloud environments and evaluate various cloud service models and RESTful services.											
2. Develop skills in auditing and data management to ensure security and integrity in cloud deployments.											
3. Implement centralized logging and monitoring strategies to improve operational efficiency in cloud systems.											
4. Gain practical experience with cloud platforms like OpenStack Swift and Google Cloud Platform (GCP).											
5. Explore automation and machine learning techniques for intelligent cloud resource optimization and self-managed systems.											
Course Outcomes:											
CO1: Design cloud architecture and choose appropriate service models using RESTful APIs.											
CO2: Conduct cloud audits and apply data security practices and centralized logging methods.											
CO3: Configure and manage Open Stack Swift storage and optimize hardware and performance settings.											
CO4: Utilize GCP services and automation tools such as Deployment Manager, Spinnaker, and Tekton for cloud operations.											
CO5: Apply machine learning models for cloud workload analysis, prediction, and self-directed optimization strategies.											
Unit - I	Managing Cloud								15 Hrs.		
Architecture – Choosing Cloud Service Model – RESTFUL services – Auditing Cloud –Data Management in cloud – Security Design – Centralized Logging Strategy – SLA Management – Monitoring Strategies – Disaster Recovery Planning											
Unit - II	Managing Cloud Storage								15 Hrs.		
OpenStack Swift Architecture – Installing OpenStack Swift – Using Swift – Managing Swift – Choosing Hardware – Tuning Swift Installation – Advanced Features											
Unit - III	Google Cloud Platform (GCP) Administration								15 Hrs.		
GCP Overview – GCP Compute – GCP Storage – GCP Networking – GCP Containers – GCP Operations – GCP Identity and Security											
Unit - IV	Cloud Automation								15 Hrs.		
GCP Automation – Google Cloud Deployment Manager – Spinnaker on GCP– Tekton on GCP											
Unit - V	Machine Learning for Cloud Management								15 Hrs.		
Workload Traces – Experimental Setup & Evaluation Metrics – Statistical Tests – Time Series Models – Error Preventive Time Seri Models – Metaheuristic Optimization Algorithms – Network Learning – Self-Directed Learning – Ensemble Learning – Advanced Features											

Text Book(s):

1. Michael J. Kavis, "Architecting The Cloud", John Wiley & Sons, 2014, ISBN: 978-1-118-61761-8 (UNIT-I)
2. Amar Kapadia, Sreedhar Varma, Kris Rajana, "Implementing Cloud Storage with OpenStack Swift", Pack Publishing, 2014, ISBN: 978-1-78216-805-8K. Chandrasekaran, "Essentials of Cloud Computing", CRC Press, 2025, ISBN 13: 978-1-4822-0544-2 ,(UNIT-II)
3. Ranjit Singh Thakurratan, "Google Cloud Platform Administration", Packt Publishing, 2018, ISBN: 978-1-78862-435-0, (UNIT-III)
4. Jitendra Kumar, Ashutosh Kumar Singh, Anand Mohan, Rajkumar Buyya, "Machine Learning for Cloud Management", CRC Press, 2021, ISBN: 9781000476590 ,(UNIT-IV)
5. Navin Sabharwal, Piyush Pandey, "Pro Google Cloud Automation: With Google Cloud Deployment Manager, Spinnaker, Tekton, and Jenkins", 1st edition, Apress, 2020, ISBN-13: 978-1484265727,(UNIT-V)

Reference Book(s):

1. Ted Hunter, Steven Porter, "Google Cloud Platform for Developers", Packt Publishing, 2018, ISBN: 978-1-78883-767-5
2. Hector Parra Martinez, "Google Cloud for Developers", Packt Publishing, 2023, ISBN: 978-1-83763-074-5
3. Sakshi Patni, Deepika Saxena, Ashutosh Kumar Singh "Resource Management in Cloud Computing: Concepts and Implementation " Springer Cham (2025)
4. Subash Natarajan, Jeeven Jacob "Multi-Cloud Handbook for Developers", Packt (February 2024)
5. Sundeepkumar Singh, Dr. Bhavesh Kataria "A Guide for Secure Design and Deployment " Technoscience Academy (March 2025).

Web Resources:

1. <https://aws.amazon.com/what-is/restful-api/>
2. <https://www.getastra.com/blog/security-audit/cloud-security-audit-everything-you-need-to-know/>
3. <https://www.techtarget.com/searchcloudcomputing/definition/cloud-audit>
4. <https://www.geeksforgeeks.org/system-design/centralized-logging-systems-system-design/>
5. <https://www.geeksforgeeks.org/cloud-computing/service-level-agreements-in-cloud-computing/>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1EC1C	4	Artificial Intelligence for Network Security	EC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite: Basic understanding of computer networks, TCP/IP protocols, and fundamental cyber security concepts.											
Course Objectives: The purpose of learning this course is:											
1. Understand basic concepts of network security and threats.											
2. Learn firewall types, filtering methods, and deployment.											
3. Explore VPN technologies, architecture, and management.											
4. Study AI applications in networking and security.											
5. Analyze real-world AI-driven network security use cases.											
Course Outcomes:											
CO1: Identify threats and design secure network systems.											
CO2: Configure and manage different firewall solutions.											
CO3: Implement secure VPNs with encryption and authentication.											
CO4: Apply AI for network optimization and threat detection.											
CO5: Evaluate AI-based tools for real-time network security.											
Unit - I	Introduction								15 Hrs.		
Network Security – Network Security Components – Network Security Threats – Network Topologies and Infrastructures – Network Design Considerations											
Unit - II	Firewalls								15 Hrs.		
Firewall Overview – Types of Firewalls – Types of Filtering – Firewall Implementation – Firewall Deployment – Configuring Firewalls											
Unit - III	Virtual Private Network								15 Hrs.		
VPN Fundamentals – VPN Deployment Models and Architecture – Relation between Encryption and VPNs – VPN Authentication and Authorization – VPN Management – VPN Technologies – VPN Implementation											
Unit - IV	AI Network Security								15 Hrs.		
AI in Networking – Benefits of AI in Networking – Key Components of AI in Networking – AI for Network Management – AI for Network Optimization – AI for Network Security – AI for Network Traffic Analysis – AI Network Tools: Cisco DNA Center – Jupiter Mist AI – Darktrace – Trellix – SolarWinds Network Performance Monitor – Aruba Netinsight											
Unit - V	Network Security Use Cases								15 Hrs.		
Real-Life examples for: AI for Network Micro segmentation – AI for Role-Based Access Control – AI for Network Detection and Response – Network Monitoring – AI for Security Information and Event Management – AI for Predictive Maintenance											

Text Book(s):

1. J. Michael Stewart, Denise Kinsey, “Network Security, Firewalls, and VPNs”, Jones & Barlett Learning, 2021 (UNIT-I,II,III)
2. Von Omar Santos, Samer Salam, Hazim Dahir, “ The AI Revolution in Networking Cybersecurity, and Emerging Technologies”, Addison-Wesley Professional, 2024, ISBN: 9780138293635 (UNIT-IV,V)

Reference Book(s):

1. Omar Santos, Samer Salam, Hazim Dahir, “The AI Revolution in Networking, Cybersecurity, and Emerging Technologies”, Addison-Wesley Publisher, 2024
2. Gert De Laet, Gert Schauwers, “Network Security Fundamentals”, Cisco Press, 2005, ISBN: 1-587051672.
3. Alessandro Paisi, “Hands-On Artificial Intelligence for Cybersecurity”, Packt Publishing Ltd., 2019, ISBN: 978-1-78980-402-7
4. William Stallings – Network Security Essentials: Applications and Standards – 7th Edition, Pearson, 2023
5. Zonghua Zhang, Hong Liu – Artificial Intelligence for Cybersecurity: Methods, Issues, and Challenges – Springer, 2022.

Web Resources:

1. <https://www.netacad.com/courses/cybersecurity>
2. <https://www.nist.gov/cyberframework>
3. <https://owasp.org/>
4. <https://ieeexplore.ieee.org/>
5. <https://www.mindgrasp.ai/>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1EC1D	4	Virtual Reality And Augmented Reality	EC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of programming (C#/Java), computer graphics, and familiarity with object-oriented concepts. Understanding of multimedia tools and human-computer interaction is recommended. 											
Course Objectives: The purpose of learning this course is:											
1. Introduce the fundamentals of AR, VR, and XR technologies.											
2. Familiarize students with Unity3D and AR/VR development tools.											
3. Explain design principles, scripting, and hardware requirements for immersive systems.											
4. Develop skills in creating AR/VR projects with assets, components, and environments.											
5. Explore applications, trends, and challenges of AR/VR in various industries.											
Course Outcomes:											
CO1: Understand key concepts and history of AR, VR, and XR.											
CO2: Use Unity3D and SDKs to design immersive applications.											
CO3: Apply design theories, scripting, and asset management in AR/VR development.											
CO4: Demonstrate knowledge of hardware technologies for 3D user interfaces.											
CO5: Build and evaluate AR/VR prototypes for real-world applications.											
Unit - I	INTRODUCTION TO AUGMENTED REALITY									15 Hrs.	
Introduction to Augmented Reality (AR), Virtual Reality (VR), eXtended Reality (XR) - Introduction to UNITY3D and Content Generation Tools - History, evolution and market impact - Sample applications of AR, VR, XR: Presentation											
Unit - II	DESIGN THEORY OF AR									15 Hrs.	
Design application: Theory - Story and process - Scripting principles - Hardware: AR, VR, XR - Hardware: Development environment - Tools, Software Development Kit (SDK), Scripting											
Unit - III	AR DEVELOPMENT									15 Hrs.	
Basic development: Identifying basic design principles, reciting common choices, styles, and/or aesthetics Visual, auidal, interactive, and narrative – System Dynamics and Scripting Fundamentals - Interfaces, Environments, Asset Management, and Animation - Project 1: Creating a project and environment - Project 2: Creating and using an asset - Project 3: Creating and using a Component											
Unit - IV	VIRTUAL REALITY AND VIRTUAL ENVIRONMENTS									15 Hrs.	
The historical development of VR: Scientific landmarks Computer Graphics, Realtime computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality. HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES: Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces.											
Unit - V	3D USER INTERFACE INPUT HARDWARE									15 Hrs.	
Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home Brewed Input Devices, Choosing Input Devices for 3D Interfaces.											

Text Book (s):

1. Erin Pangilinan, Steve Lukas, et al. 'Creating Augmented and Virtual Realities: Theory and Practice for Next- Generation Spatial Computing', Apr 14, 2019 (UNIT-I)
2. Steve Aukstakalnis, 'Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)',2016 (UNIT-II)
3. Jonathan Linowes, 'Augmented Reality for Developers: **Book** Build practical augmented reality applications with UNITY, ARCore, ARKit, and Vuforia',October 9, 2017 (UNIT-III)
4. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann,2009.(UNIT-IV)
5. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.(UNIT-V)

Reference Book(s)

1. Raghav Sood – "Mastering Augmented Reality Development with Unity", Packt, 2020.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Michael Wohl, "The 360° Video Handbook: A step-by-step guide to creating video for virtual reality (VR)", July 1, 2017
4. John Bucher, "Storytelling for Virtual Reality: Methods and Principles for Crafting Immersive Narratives", Jul 6, 2017
5. Jonathan Linowes, "UNITY Virtual Reality Projects: Learn Virtual Reality by developing more than 10

Web Resources:

1. <https://nptel.ac.in/courses/106/106/106106138/>
2. <https://gamedevacademy.org/category/vr-ar-tutorials/>
3. <https://code.tutsplus.com/tutorials/beginners-guide-to-augmented-reality--active-4948>
4. <https://nptel.ac.in/courses/106/106/106106138/>
5. <https://gamedevacademy.org/category/vr-ar-tutorials/>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1VAC1	2	Hardware and Networking Essentials(Value Added Course 1)	VAC	-	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
Basic knowledge of computer fundamentals, operating systems, and familiarity with hardware components and networking concepts.											
Course Objectives: The purpose of learning this course is:											
1. To provide knowledge of basic computer components, peripherals, and their functions.											
2. To understand PC architecture, processors, motherboards, and assembly/disassembly.											
3. To explain memory hierarchy, storage devices, and data management techniques.											
4. To introduce fundamentals of computer networks, protocols, and addressing.											
5. To study network connectivity devices and their role in communication.											
Course Outcomes:											
CO1: Identify and explain the functions of basic computer hardware and peripherals.											
CO2: Demonstrate knowledge of PC architecture, CPU, motherboard, and assembly process.											
CO3: Differentiate between types of memory and secondary storage devices.											
CO4: Apply concepts of networking, OSI/TCP-IP models, and IP addressing.											
CO5: Analyze and configure network connectivity devices for effective communication.											
Unit - I	Basic Computer Systems & Peripherals								6Hrs.		
Basic computer system – Main system unit – Peripherals – Keyboard – keyboard types – keyboard organization – keyboard ergonomic – interfacing -Mouse- mouse types –mouse interface - Printer – printer types - Monitor – monitor types -Scanner – Digital camera - Laptop, PDA - Notebook computer											
Unit - II	PC Architecture & Components								6 Hrs.		
PC Architecture: The Case – Case types - The Power Supply - power supply types - Motherboard – motherboard chipset - motherboard types – Motherboard architecture –motherboard installation - Processor/CPU – Processor types – Latest processor types -processor installation- Adapter Cards - Display Devices - Ports and Cables – Assemble the PC – Disassemble the PC											
Unit - III	Computer Memory & Storage Devices								6 Hrs.		
Memory – Primary memory - RAM, ROM, ECC, DIP, SIPP, SIMM, DIMM, RIMM, DDR, XMS memory, Cache memory, shadow memory – POST – BIOS – Secondary memory – HDD – types of hard disk drives - tracks – sectors – installing and upgrading – partitioning - magnetic recording – CHKDSK- SCANDISK – FDISK – Optical disks – DVD – Blu-Ray											
Unit - IV	Computer Networks & Models								6 Hrs.		
Network: Introduction – Uses of Computer Networks – Network Hardware: Personal Area Networks –Local Area Networks – Metropolitan Area Networks – Wide Area Networks – Internetworks –Protocols - Reference Models: The OSI Reference Model –The TCP/IP Reference Model -IP address											
Unit - V	Network Connectivity & Devices								6 Hrs.		
Network Connectivity devices: Network Interface Card (NIC) – Types of NIC – Configuration of NIC - Repeaters – Hubs - Switches – Switch types - Bridges - Routers – Modems - types of Modems - Gateways – WIFI – Bluetooth – Access Point											

Text Book(s):

1. Manahar Lotia & Others, "Modern Computer Hardware Course", BPB, First Edition, 2004.(UNIT-I & II)
2. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", PHI, 2003.(UNIT-III)
3. K.L. James, "Computer Hardware, Installation, Interfacing, Troubleshooting and Maintenance", 2013(UNIT-IV)(UNIT-V)

Reference Book(s):

1. Tom Carpenter – Networking Essentials: A CompTIA Network+ N10-008 Textbook, Sybex, 2022.
2. Javvin Technologies – Computer Networking Illustrated, Updated 2023.
3. Quentin Docter – CompTIA A+ Certification All-in-One Exam Guide (220-1101 & 220-1102), McGraw Hill, 2022.
4. Jean Andrews – A+ Guide to IT Technical Support (Hardware and Software), Cengage, 2020
5. Computer Hardware Technology: Powering the Digital World

Web Resources:

1. <https://www.computerhope.com/jargon/c/computer.htm>
2. <https://www.geeksforgeeks.org/computer-hardware-basics/>
3. <https://www.tomshardware.com/>
4. https://www.tutorialspoint.com/computer_fundamentals/computer_memory.htm
5. <https://www.opencompute.org/...>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1BC1	4	Programming in C and C++	BC	4	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic understanding of computer fundamentals and programming logic. Familiarity with problem-solving techniques and flowcharts. 											
Course Objectives: The purpose of learning this course is:											
1. Introduce fundamental concepts of C and C++ programming languages.											
2. Develop skills in writing programs using control structures, arrays, functions, and file handling											
3. Familiarize students with structures, unions, pointers, and string operations.											
4. Introduce Object-Oriented Programming concepts and principles.											
5. Apply OOP features like classes, objects, overloading, inheritance, and file streams for real-world problems.											
Course Outcomes:											
CO1: Write C programs using variables, constants, operators, I/O functions, and control structures.											
CO2: Implement modular programming using functions and arrays.											
CO3: Use structures, unions, pointers, and file handling for data processing.											
CO4: Explain OOP concepts and implement C++ programs using classes and objects.											
CO5: Apply advanced OOP concepts such as overloading, inheritance, and file streams in application development.											
Unit - I	Fundamentals of C Programming								9 Hrs.		
History, Execution of C Program, Constants, Variables and Keywords, Data types, Expressions, constants, variables, Operators, Formatted Console I/O Functions, Conversion Specifications, assignment statements, conditional statements, Looping Statements											
Unit - II	Arrays and Modular Programming								9 Hrs.		
Array and Modular Programming: Introduction to Function, Functions with Simple Output Parameters- Arrays: Declaring and Referencing Arrays, Array Subscripts, Using for Loops for Sequential Access											
Unit - III	Advanced C Concepts: Structures, Pointers, Strings & Files								9 Hrs.		
Structures, Unions, Strings, Pointers and files: Structures & Unions- definition-Pointers: Operations on Pointers – String handling - Text and data file processing.											
Unit - IV	Introduction to Object-Oriented Programming with C++								9 Hrs.		
Evolution of OOP, OOP Paradigm, advantages of OOP, Comparison between functional programming and OOP Approach, characteristics of object oriented language. Introduction to C++, Identifier and keywords, constants, C++ operators, type conversion, Variable declaration, statements, expressions, input and output, Conditional expression, loop statements, breaking control statements.											
Unit - V	C++ Advanced Concepts: Classes, Overloading & File Handling								9 Hrs.		
Classes and objects, constructors and destructors, function and operator overloading, inheritance, manipulators, File streams, classes file modes.											

Text Book(s):

1. E. Balagurusamy, “Programming in ANSI C”, Tata McGraw Hill, New Delhi, 8th Edition, 2019.(UNIT-I)(UNIT-II)(UNIT-III)
2. E. Balagurusamy, “Object-oriented Programming with C++”, Tata McGrawHill, New Delhi, 7th Edition,2017.Herbert Schildt, “C++: The Complete Reference”, McGraw Hill Education India, 4th Edition, 2017. (UNIT-IV)(UNIT-V).

Reference Book(s):

1. Bjarne Stroustrup –“ Programming: Principles and Practice Using C++”, *2nd Edition, Addison-Wesley, 2022.*
2. Greg Perry & Dean Miller – “C Programming Absolute Beginner’s Guide”, 4th Edition, Addison-Wesley, 2021.
3. Yashavant Kanetkar –“Let Us C”, 17th Edition, BPB Publications, 2023.
4. Stanley B. Lippman, Josée Lajoie, & Barbara E. Moo – “C++ Primer”, 6th Edition, Addison-Wesley, 2024.
5. Andrew Koenig & Barbara Moo – Accelerated C++: Practical Programming by Example, 2020 Reprint, Addison-Wesley.

Web Resources:

1. <https://www.khanacademy.org/computing/computer-programming>
2. https://www.w3schools.com/c/c_intro.php
3. <https://www.geeksforgeeks.org/c-programming-language/>
4. <https://www.javatpoint.com/c-programming-language-tutorial>
5. <https://www.programiz.com>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		3 Hrs.	CIA	ESE
I	25PCA1BC2	4	Fundamental Of Data Structures	BC	4	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of C programming (variables, loops, functions, pointers). Understanding of basic mathematics and logic building. 											
Course Objectives: The purpose of learning this course is:											
1. Understand Abstract Data Types and their implementations.											
2. Apply stacks, queues, and linked lists to solve real-world problems.											
3. Implement efficient searching and sorting algorithms.											
4. Learn tree and graph structures with their traversals and applications.											
5. Develop problem-solving skills using appropriate data structures.											
Course Outcomes:											
CO1: Implement List ADT using arrays and linked lists.											
CO2: Apply Stack and Queue ADTs for applications like expression evaluation and palindrome checking.											
CO3: : Implement searching (linear, binary) and sorting algorithms (insertion, merge, quick, heap).											
CO4: Create and traverse binary trees, expression trees, and binary search trees.											
CO5: Represent graphs and perform BFS and DFS traversals.											
Unit - I	ABSTRACTDATA TYPES (ADTs)									9 Hrs.	
List ADT – array-based implementation – linked list implementation – singly linked lists- applications of lists: Polynomial Manipulation. Implementation of List ADT using an array and using a linked list in C.											
Unit - II	STACKSAND QUEUE									9 Hrs.	
Stack ADT - Applications - Evaluating arithmetic expressions- Conversion of Infix to Postfix- Recursion. Queue ADT – Priority Queue - applications of queues. Implementation of Stack ADT and palindrome checking using C. Implementation of Queue operations using arrays in C.											
Unit - III	SEARCHING AND SORTING ALGORITHMS									9 Hrs.	
Divide and conquer methodology -Searching: Linear Search - Binary Search. Sorting: Insertion sort – Merge sort – Quick sort – Heap sort.											
Unit - IV	TREES									9 Hrs.	
ADT – Tree traversals - Binary Tree ADT – expression trees – binary search tree ADT – applications of trees.											
Unit - V	GRAPHS									9 Hrs.	
Definition – Representation of Graph – Breadth-first traversal – Depth first traversal											

Text Book(s):

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education, 1997 (UNIT-I)(UNIT-II).
2. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, 2nd Edition, Pearson Education, 1988.(UNIT-III)
3. S.Sridhar, “Design and Analysis of Algorithms”, First Edition, Oxford University Press. 2014. (UNIT-IV)(UNIT-V).

Reference Book(s):

1. Aho, Hopcroft and Ullman, “Data Structures and Algorithms”, Pearson Education, 1983.
2. Byron Gottfried, Jitender Chhabra, “Programming with C” (Schaum’s Outlines Series), Mcgraw Hill Higher Ed., III Edition, 2010 .Yashvant Kanetkar, “Data Structures Through C”, BPB publications, 2nd edition, 2003.
3. Seymour Lipschutz & G.A.V. Pai –“ Data Structures with C (Schaum’s Outlines) ”, 2nd Edition, McGraw Hill, 2020.
4. Reema Thareja – “Data Structures Using C”, 5th Edition, Oxford University Press, 2022.
5. Yashavant Kanetkar – “Data Structures Through C”, Revised Edition, BPB Publications, 2020.

Web Resources:

1. <https://www.simplilearn.com/tutorials/data-structure-tutorial/what-is-data-structure>
2. <https://www.coursera.org/specializations/boulder-data-structures-algorithms>
3. <https://www.geeksforgeeks.org/data-structures/>
4. <https://techdevguide.withgoogle.com/paths/data-structures-and-algorithms/>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
I	25PCA1BC3P	2	Programming in C and C++ Lab	BP	-	-	3	3 Hrs.	40	60	100
Pre-Requisite:											
<ul style="list-style-type: none"> • Basic understanding of computer fundamentals and problem-solving. • Familiarity with flowcharts or pseudocode. 											
Course Objectives: The purpose of learning this course is:											
1. Learn fundamentals of C programming including data types, operators, and control structures.											
2. Develop modular programs using arrays, strings, functions, and recursion.											
3. Understand core object-oriented concepts in C++.											
4. Implement classes, objects, constructors, and member functions.											
5. Apply advanced OOP features like overloading and file handling.											
Course Outcomes:											
CO1. Write C programs using operators, control structures, and arrays.											
CO2. Implement modular and recursive solutions in C.											
CO3. Perform string and multi-dimensional array operations.											
CO4. Develop C++ programs with classes, objects, and constructors.											
CO5. Apply polymorphism and file handling in C++ applications.											
List of Practicals									30 Hrs.		
C-LANGUAGE:											
<ol style="list-style-type: none"> 1.Data types & Expressions, Constants & Variables, Operators, Operator Precedence and associativity, Storage Classes. 2.Conditional statements, Looping Statements, Array and Modular Programming. 3.Basic Array programs using for loop, User defined functions, Recursion. 4.Programs on Two dimensional Arrays, Passing arrays as arguments, Stringhandling based on String Functions and Character Operation. 											
C++ - LANGUAGE:											
<ol style="list-style-type: none"> 1. Program using functions, functions with default arguments, implementation of call by value, address, reference. 2. Simple classes for understanding objects, member functions & constructors. 3. classes with primitive data members, classes with arrays as data members. 4. classes with pointers as data members, classes with constant data members. 5. classes with static member functions. 6. Compile time polymorphism: operator overloading, function overloading. 7. File handling, sequential access, random access. 											

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS / VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CC3	5	Design And Analysis Of Algorithms	CC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of programming in C/C++, mathematics fundamentals, and discrete structures. 											
Course Objectives: The purpose of learning this course is:											
1. Understand the fundamentals of algorithmic problem-solving and complexity analysis.											
2. Learn mathematical methods for analyzing and solving algorithmic recurrence relations.											
3. Explore problem-solving strategies using brute force and divide-and-conquer methods.											
4. Develop problem-solving skills using greedy algorithms and dynamic programming.											
5. Understand backtracking and branch-and-bound approaches for complex problem-solving.											
Course Outcomes:											
CO1: Analyze algorithm efficiency using time, space, and asymptotic notations.											
CO2: Solve recurrences and apply linear-time sorting techniques.											
CO3: Implement algorithms like TSP, quick sort, merge sort, and Strassen's multiplication.											
CO4: Solve problems using Huffman coding, job sequencing, and optimal binary search trees.											
CO5: Apply these methods to N-queens, Hamiltonian circuits, and NP-complete problems.											
Unit - I	INTRODUCTION								15Hrs.		
Fundamentals of Algorithmic Problem Solving - Time Complexity - Space complexity with examples - Growth of Functions - Asymptotic Notations: Need, Types - Big Oh, Little Oh, Omega, Theta - Properties - Complexity Analysis Examples - Performance measurement - Instance Size, Test Data, Experimental setup											
Unit - II	MATHEMATICAL FOUNDATIONS								15Hrs.		
Solving Recurrence Equations - Substitution Method - Recursion Tree Method - Master Method - Best Case - Worst Case - Average Case Analysis - Sorting in Linear Time - Lower bounds for Sorting: - Counting Sort - Radix Sort - Bucket Sort											
Unit - III	BRUTE FORCE AND DIVIDE-AND-CONQUER:								15Hrs.		
Brute Force: Travelling Salesman Problem - Knapsack Problem - Assignment Problem - Closest Pair and Convex Hull Problems - Divide and Conquer Approach:- Binary Search - Quick Sort - Merge Sort - Strassen's Matrix Multiplication.											
Unit - IV	GREEDY APPROACH AND DYNAMIC PROGRAMMING								15Hrs.		
Greedy Approach: Optimal Merge Patterns- Huffman Code - Job Sequencing problem- -- Tree Vertex Splitting Dynamic Programming:- Dice Throw—Optimal Binary Search Algorithms.											
Unit - V	BACKTRACKING AND BRANCH AND BOUND								15Hrs.		
Backtracking:- 8 Queens - Hamiltonian Circuit Problem - Branch and Bound - Assignment Problem - Knapsack Problem:- Travelling Salesman Problem - NP Complete Problems - Clique Problem - Vertex Cover Problem .											

Text Book(s):

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Third Edition, Pearson Education, 2012. [Unit I]
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third [Unit II]
3. Ellis Horowitz, Sartaj Sahni and SanguthevarRajasekaran, Fundamentals of Computer Algorithms, Second Edition, Universities Press, 2007 [Unit III] [Unit V]
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms David E. Goldberg, “Genetic Algorithm In Search Optimization And Machine Learning” Pearson Education India, 2013. [Unit IV]

Reference Book(s):

1. Steven S. Skiena, “The Algorithm Design Manual”, 3rd Edition, Springer, 2020.
2. Thomas H. Cormen et al., “Introduction to Algorithms”, 4th Edition, MIT Press, 2022.
3. Anany Levitin, “Algorithm Design and Applications”, Pearson, 2015.
4. Aditya Bhargava, “Grokking Algorithms”, 2nd Edition”, Manning, 2024
5. Vijaya K. Varadan, “Advanced Design and Analysis of Algorithms”, Springer, 2019.

Web Resources:

1. <https://www.geeksforgeeks.org/sorting-algorithms/>
2. https://www.tutorialspoint.com/data_structures_algorithms/dynamic_programming.
3. <https://brilliant.org/wiki/graph-algorithms/>
4. <https://www.geeksforgeeks.org/backtracking-algorithms/>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CC4	5	Advanced Operating Systems	CC	5	-	-	3 Hrs.	25	75	100

Pre-Requisite:

- Basic knowledge of Operating System concepts (processes, memory management, file systems)
- Understanding of computer architecture and networking fundamentals

Course Objectives: The purpose of learning this course is:

1. Understand architectures, design issues, and process management in multiprocessor OS.
2. Learn design concepts and coordination mechanisms in distributed OS.
3. Study scheduling, memory sharing, and file management in distributed systems.
4. Understand requirements and concurrency control in database OS.
5. Learn architectures, kernel structures, and power management techniques for mobile OS.

Course Outcomes:

CO1: Analyze and apply process synchronization, scheduling, and memory management techniques.

CO2: Implement clock synchronization, mutual exclusion, and deadlock detection in distributed systems.

CO3: Apply distributed scheduling, file placement, and caching strategies effectively

CO4: Apply transaction models and synchronization primitives for database operations.

CO5: Optimize mobile OS performance and power usage in ARM/Intel-based systems.

Unit - I	MULTIPROCESSOR OPERATING SYSTEMS	12 Hrs..
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System Architectures- Structures of OS –OS design issues –Process synchronization – Process Scheduling and Allocation memory management.

Unit - II	DISTRIBUTED OPERATING SYSTEMS	12 Hrs.
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System Architectures- Design issues –Communication models –clock synchronization – mutual exclusion – election algorithms- Distributed Deadlock detection

Unit - III	DISTRIBUTED SCHEDULING:	12 Hrs.
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Distributed scheduling - Distributed shared memory - Distributed File system –Multimedia file systems - File placement - Caching

Unit - IV	DATABASE OPERATING SYSTEMS	12 Hrs.
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Requirements of Database OS – Transaction process model – Synchronization primitives - Concurrency control algorithms

Unit - V	MOBILE OPERATING SYSTEMS	12 Hrs.
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ARM and Intel architectures - Power Management -Mobile OS Architectures - Underlying OS - Kernel structure and native level programming – Runtime issues- Approaches to power management

Text Book(s):

1. MukeshSinghal and Niranjana G. Shivaratri, “Advanced Concepts in Operating Systems Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001. [Unit I] [Unit III] [Unit IV]
2. A S Tanenbaum, Distributed Operating Systems, Pearson Education Asia,2001. [Unit II]
3. Source Wikipedia, Mobile Operating Systems, General Books LLC, 2010. [Unit V]

Reference Book(s):

1. Silberschatz, Galvin, Gagne, "Operating System Concepts", 10th Edition, Wiley, 2018.
2. Andrew S. Tanenbaum & Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 2nd Edition, Pearson, 2017.
3. Pradeep K. Sinha, "Distributed Operating Systems: Concepts and Design", PHI, 2017.
4. Raghu Ramakrishnan & Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw Hill, 2014.
5. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley, 2021.

Web Resources:

1. <https://www.javatpoint.com/os-tutorial>
2. <https://www.khanacademy.org/computing/computer-science>
3. http://www.uobabylon.edu.iq/download/M.S%2020132014/Operating_System_Concepts,_8th_Edition%5BA4%5D.pdf
4. <http://indexof.es/Varios2/Modern%20Operating%20Systems%204th%20Edition.pdf>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CP2	2	Operating Systems Lab	CC	-	-	3	3 Hrs.	40	60	100

Pre-Requisite:

- Basic knowledge of C programming, computer organization, and fundamentals of operating systems.

Course Objectives: The purpose of learning this course is:

1. Understand core concepts of operating systems.
2. Develop skills to implement process scheduling, memory management, and IPC.
3. Apply UNIX/Linux system calls for file and process handling.
4. Simulate deadlock handling and avoidance techniques.
5. Implement synchronization mechanisms using semaphores.

Course Outcomes:

CO1: Demonstrate CPU scheduling and memory management techniques.

CO2: Use UNIX/Linux system calls for file, process, and IPC operations.

CO3: Implement algorithms for deadlock prevention/avoidance.

CO4: Apply synchronization in concurrent processes.

CO5: Design and simulate OS functionalities effectively.

List of Practical

45 Hrs.

1. Simulate the following CPU Scheduling algorithms
a) FCFS b) SJF c) Round Robin d) priority
2. Write programs using the I/O system calls of UNIX/LINUX operating system(open, read, write, close, fcntl, seek, stat, opendir, readdir).
3. Simulate Bankers Algorithm for Deadlock Avoidance and Prevention.
4. Implement the Producer – Consumer problem using semaphores using UNIX/LINUX system calls.
5. Illustrate the following IPC mechanisms
a) Pipes b) FIFOs c) Message Queues d) Shared Memory
6. Simulate the following memory management techniques
a) Paging b) Segmentation

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					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CC2A	4	Natural Language Processing	CCC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> • Basic knowledge of programming, probability, and linguistics. 											
Course Objectives: The purpose of learning this course is:											
1. Understand fundamental concepts and stages of NLP.											
2. Perform text preprocessing and morphological analysis.											
3. Apply statistical and probabilistic methods for language modeling.											
4. Implement word sense disambiguation techniques.											
5. Analyze syntax, semantics, and apply NLP in real-world applications.											
Course Outcomes:											
CO1: Explain NLP concepts and challenges, including ambiguity.											
CO2: Preprocess text and analyze morphological structures.											
CO3: Build and evaluate n-gram and statistical language models.											
CO4: Apply supervised and dictionary-based WSD methods.											
CO5: Perform shallow parsing, semantic role labeling, and implement NLP applications like sentiment analysis and machine translation.											
Unit - I	INTRODUCTION TO NLP								12Hrs.		
Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult- Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross entropy.											
Unit - II	TEXT PREPROCESSING AND MORPHOLOGY								12Hrs.		
Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.											
Unit - III	LANGUAGE MODELLING								12Hrs.		
Words - Collocations- Frequency-Mean and Variance –Hypothesis testing: The t test, Hypothesis testing of differences, Pearson’s chi-square test, Likelihood ratios. Statistical Inference: n -gram Models over Sparse Data: Bins: Forming Equivalence Classes- N gram model - Statistical Estimators- Combining Estimators.											
Unit - IV	WORD SENSE DISAMBIGUATION								12Hrs.		
Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, An information- theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus- based disambiguation, Disambiguation based on translations in a second-language corpus.											
Unit - V	SYNTAX AND SEMANTICS								12Hrs.		
Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Net, Thematic Roles, Semantic Role Labeling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction, Text mining, Information Retrieval, NL interfaces, Sentimental Analysis, Question Answering Systems, Social network analysis.											

Text Book(s):

1. Christopher D. Manning and Hinrich Schütze, “ Foundations of Natural Language Processing” , 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003 [unit -I]
2. Daniel Jurafsky and James H. Martin “Speech and Language Processing”, 3rd edition, Prentice Hall, 2009. [unit -III]
3. Nitin Indurkha, Fred J. Damerau “Handbook of Natural Language Processing”, Second Edition, CRC Press, 2010. [unit -II] [unit -IV]
4. Alexander Clark, Chris Fox, Shalom Lappin, “The Handbook of Computational Linguistics and Natural Language Processing”, Wiley-Blackwell, 2012 [unit -V]

Reference Book(s):

1. Manning, C.D. & Schütze, H., Foundations of NLP, MIT Press, 2003
2. Allen, J., Natural Language Understanding, Pearson, 2012
3. Jurafsky, D. & Martin, J.H., Speech and Language Processing, 3rd Edition, 2009
4. Lane, H., Howard, C., Hapke, H., Natural Language Processing in Action, Manning Publications, 2019
5. Arumugam, R. & Shanmugamani, R., Hands-on NLP with Python, PACKT, 2018

Web Resources:

1. https://www.tutorialspoint.com/natural_language_processing/index.html
2. <https://www.javatpoint.com/nlp>
3. <https://developer.ibm.com/technologies/natural-languageprocessing/tutorials>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CC2B	4	Advanced Computer Networks	CCC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> • Basic understanding of computer networks (OSI model, TCP/IP, routing) • Knowledge of data communication concepts and network protocols. 											
Course Objectives: The purpose of learning this course is:											
1.Refresh core networking principles, protocols, and traffic modeling techniques.											
2.Understand router design, QoS scheduling, and mobility in wireless networks.											
3.Learn TCP variants, congestion management, and overlay networking concepts.											
4.Explore advanced network architectures and modern protocol enhancements.											
5.Study OSNs, WSNs, and application protocols for multimedia communication.											
Course Outcomes:											
CO1: Analyze network layers, routing, congestion control, and traffic modeling methods.											
CO2: Implement QoS mechanisms, MAC protocols, and multicast routing in wireless networks.											
CO3: Apply TCP optimization and overlay network techniques such as P2P, CDN, and web caching.											
CO4: Configure and analyze data center, LTE/Wi-Max networks, and mobile IP implementations.											
CO5: Implement sensor data dissemination and emerging applications like VoIP and video over P2P.											
Unit - I	BASIC NETWORKING CONCEPTS REVISITED								12Hrs.		
Introduction to networks, layering and link layer, network layer, routing, end-to-end layer, congestion control, Modeling and measurement: network traffic modeling, network measurement, simulation issues, network coding techniques.											
Unit - II	ROUTING AND ROUTER DESIGN								12Hrs.		
Scheduling and QoS, integrated and differentiated services, RSVP. Wireless networks and mobility supports, MAC protocol, routing, AODV, group communication, multicast											
Unit - III	FLOW AND CONGESTION CONTROL								12Hrs.		
TCP variants, TCP modeling, active queue. Management. Overlay networks: RON, P2P, CDN, Web caching, cross-layer Optimizations											
Unit - IV	EMERGING NETWORK TYPES								12Hrs.		
Data center, DTN, 4G mobile networks. (LTE, Wi-Max). The internet protocols: TCP and UDP, Multicast routing, Mobility in networks, Mobile IP, Emerging trends in networking.											
Unit - V	ONLINE SOCIAL NETWORKS(OSN)								12Hrs.		
Wireless sensor networks (WSN) – cross-layer sensor data dissemination. Emerging applications – VoIP, SIP, video over P2P.											

Text Book(s):

1. B.A. Forouzan, “Data communication & networking”, 5th Edition, Tata Mc-Graw Hills. [Unit I]
2. Andrew S. Tanenbaum, “Computer Networks”, Pearson Publications. [Unit II] [Unit IV]
3. L.L. Peterson and BS. Davie, “Computer Networks ISE: A System Approach”, 5th edition, Morgan Kaufman. [Unit III]
4. J.F. Kurose and K.W. Ross, “Computer networking: A top-down approach”, 6th edition, Addison Wesley. [Unit III]
5. Robert Faludi, “Building Wireless Sensor Network”, O’Reilly Publisher. [Unit V]

Reference Book(s):

1. Behrouz A. Forouzan, “Data Communication & Networking”, 6th Edition, McGraw Hill, 2021.
2. Olivier Bonaventure, “Computer Networking: Principles”, Protocols, and Practice, 2nd Edition, 2020
3. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2021.
4. Stevens, W. R., & Fall, K. R., “TCP/IP Illustrated, Volume 1: The Protocols”, 2nd Edition, Addison-Wesley, 2011. ISBN: 978-0321336316
5. Grigorik, I., “High-Performance Browser Networking”, 1st Edition, O’Reilly Media, 2013. ISBN: 978-1449344764

Web Resources:

1. <https://networkdirection.net/>
2. <https://networkdirection.net/articles/routingandswitching/routingdesign/>
3. <https://www.gatevidyalay.com/tag/tcp-congestion-control-tutorial/>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CC2C	4	Computer Graphics And Animation	CCC	5	1	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> • Basic knowledge of programming (C/C++ or Java) • Understanding of mathematics for graphics, including geometry and linear algebra 											
Course Objectives: The purpose of learning this course is:											
1. Learn algorithms for drawing lines, circles, ellipses, and setting primitive attributes.											
2. Understand geometric transformations, viewing pipeline, and clipping algorithms.											
3. Study 3D object representation and transformation methods.											
4. Learn animation principles, camera movement, and framework design.											
5. Understand pipeline and multimodal input challenges in animation.											
Course Outcomes:											
CO1: Implement efficient line, circle, and ellipse generation with proper attributes.											
CO2: Apply transformations and clipping techniques for 2D graphics rendering.											
CO3: Create and manipulate 3D models using geometric and modeling transformations.											
CO4: Develop basic animations with controlled viewpoints.											
CO5: Implement view-dependent animations from multimodal inputs.											
Unit - I	OUTPUT PRIMITIVES								12Hrs.		
Points and Lines, Line-Drawing Algorithms: DDA Algorithm, Bresenham's Line Algorithm, Line Function, Circle Generation Algorithms, Ellipse Generation Algorithms - Attributes of output Primitives: Line Attributes- Color and Gray Scale levels, Area Fill Attributes, Character Attributes, Bundled Attributes, Antialiasing											
Unit - II	TWO DIMENSIONAL GEOMETRIC TRANSFORMATIONS								12Hrs.		
Basic Transformations, Matrix Representation and Homogenous Coordinates, Composite Transformations, Other Transformations. Two Dimensional Viewing: The Viewing pipeline, Viewing Coordinate Reference Frame, Window to Viewport Coordinate Transformations, Two Dimensional Viewing Functions, Clipping Operations, Point Clipping, Line Clipping: Cohen-Sutherland Line Clipping, Polygon Clipping: Sutherland-Hodgeman Polygon Clipping.											
Unit - III	THREE DIMENSIONAL CONCEPTS								12Hrs.		
Three Dimensional Display Methods - Three Dimensional Object Representations: Polygon Surfaces, Quadric Surfaces, Superquadrics. Three Dimensional Geometric and Modeling Transformations: Translation, Rotation, Scaling, Other Transformations, Composite Transformations, Three Dimensional Transformation Functions.											
Unit - IV	ANIMATION								12Hrs.		
Introduction to Animation – Principles of Animation - Pipeline – Moving Camera Character - Designing and Framework for View Dependent Animation – The View Space – Distance of Viewpoint.											
Unit - V	DEPENDENT ANIMATION								12Hrs.		
Overview of pipeline – Inputs – Recovering the Camera – Posing the Character – Animating the Character- View Dependent Animation from Multimodal Inputs : Challenges in Multimodel Authoring of Animation – Creating a View Space from Video											

Text Book(s):

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi, 2007 [Unit – I] [Unit – II] [Unit – III]
2. Parag Chaudhuri, Prem Kalra and Subhashis Banerjee, "View Dependent Character Animation", Springer-Verlag London Limited, 2007 [Unit – IV] [Unit – V]
3. Jeffrey McConnell, —Computer Graphics: Theory into Practice, Jones and Bartlett Publishers, 2006. [Unit – II]
4. Hill F S Jr., "Computer Graphics", Maxwell Macmillan, 1990. [Unit – III]

Reference Book(s):

1. Foley, J.D., Van Dam, A., Feiner, S.K., Hughes, J.F., "Computer Graphics: Principles and Practice", 2nd Edition, Pearson Education, 2003.
2. Baker, P., Hearn, D., "Computer Graphics with OpenGL", 3rd Edition, Pearson, 2004.
3. Shreiner, D., Woo, M., Neider, J., Davis, T., "OpenGL Programming Guide", 8th Edition, Addison-Wesley, 2013.
4. Rick Parent, "Computer Animation: Algorithms and Techniques", 3rd Edition, Morgan Kaufmann, 2012.
5. Alan Watt, "3D Computer Graphics", 3rd Edition, Addison Wesley, 2000.

Web Resources:

1. <https://www.blender.org/support/tutorials/>
2. <https://www.docme.su/doc/1765678/parag-chaudhuri--prem-kalra--subhashis-banerjee---view-de...>
3. <https://www.javatpoint.com/computer-graphics-tutorial>
4. <https://www.geeksforgeeks.org/computer-graphics-2/>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CC2AP	2	Natural Language Processing Lab	CCP	-	-	3	3 Hrs.	40	60	100
Pre-Requisite:											
<ul style="list-style-type: none"> Fundamentals of Data Structures, Algorithms, and basic concepts of Artificial Intelligence. 											
Course Objectives: The purpose of learning this course is:											
1. To provide an understanding of natural language structure and its computational challenges.											
2. To train students in techniques of tokenization, morphological processing, and corpus analysis.											
3. To equip learners with statistical and probabilistic approaches for language modeling.											
4. To introduce various strategies for word sense disambiguation and semantic interpretation.											
5. To apply NLP concepts in building practical applications like sentiment analysis, information retrieval, and question answering.											
Course Outcomes:											
CO1: Demonstrate knowledge of NLP basics and explain why human language is ambiguous and complex.											
CO2: Apply preprocessing techniques and morphological tools to process raw text data.											
CO3: Construct and evaluate n-gram based language models and statistical estimators.											
CO4: Implement supervised and knowledge-based approaches for resolving word sense ambiguity.											
CO5: Analyze syntax and semantics to design and implement NLP-driven applications in real-world domains.											
List of Practical									45 Hrs.		
<ol style="list-style-type: none"> 1. Tokenization & POS Tagging – Implement word and sentence tokenization, and tag parts of speech using Python NLTK or SpaCy. 2. Text Preprocessing – Perform stopword removal, stemming, and lemmatization on a sample corpus. 3. Morphological Analysis – Analyze word inflections and derivations using Finite State Transducers. 4. Corpus Analysis – Compute word frequency, collocations, and concordances from a text corpus. 5. N-gram Language Model – Build bigram and trigram models, compute probabilities, and evaluate perplexity. 6. Hypothesis Testing on Text – Apply t-test or chi-square test to compare word distributions in two corpora. 7. Word Sense Disambiguation (WSD) – Implement supervised WSD using a labeled corpus and Naive Bayes classifier. 8. Dictionary/Thesaurus-based WSD – Disambiguate word senses using WordNet or bilingual dictionaries. 9. Shallow Parsing & Chunking – Identify noun phrases and verb phrases using CRFs. 10. NLP Applications – Implement sentiment analysis, text classification, or simple machine translation on sample datasets. 											

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					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CC2BP	2	Advanced Computer Networks Lab	CCP	-	-	3	3 Hrs.	40	60	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of Java programming, computer networks, and data communication fundamentals. 											
Course Objectives: The purpose of learning this course is:											
1. Understand fundamental concepts of computer networks and protocols.											
2. Develop skills to implement network communication using Java.											
3. Learn client-server architectures with TCP, UDP, and higher-level protocols.											
4. Apply routing and addressing techniques through simulations.											
5. Gain hands-on experience in socket programming and protocol design.											
Course Outcomes:											
CO1: Demonstrate TCP and UDP client-server communication in Java.											
CO2: Implement file transfer and chat applications using sockets.											
CO3: Simulate networking protocols like ARP, routing, and DNS.											
CO4: Apply shortest path and distance vector routing algorithms.											
CO5: Design, develop, and test network-based applications effectively.											
List of Practical									45 Hrs.		
<ol style="list-style-type: none"> Write a java program to design a TCP Client-Server application to transfer a file. Write a java program to design UDP Client-Server application to transfer a file. Write a java program to design a ARP protocol. Write a java program to distance vector routing protocol. Write a java program to Dijkstra's shortest path routing protocol. Write a Java program to develop a DNS client server to resolve the given Hostname. Implement a simple TCP client-server where in a server acts as a time and date server. Create a simple Chat Program. 											

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					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2CC2CP	2	Computer Graphics And Animation Lab	CCP	-	-	3	3 Hrs.	40	60	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of C/C++ programming, coordinate geometry, and mathematics fundamentals. 											
Course Objectives: The purpose of learning this course is:											
1. Understand the fundamentals of computer graphics concepts and algorithms.											
2. Learn line, circle, and polygon drawing techniques.											
3. Apply 2D and 3D transformation methods for object manipulation.											
4. Implement coloring, filling, and clipping algorithms.											
5. Develop simple animations using transformations and key-frame techniques.											
Course Outcomes:											
CO1: Implement basic graphics algorithms like DDA, Bresenham, and Midpoint.											
CO2: Create and transform 2D and 3D objects.											
CO3: Apply geometric transformations and filling techniques.											
CO4: Develop simple animations using key-frames and transformations.											
CO5: Design and demonstrate graphics applications using appropriate tools.											
List of Practical										45 Hrs.	
<ol style="list-style-type: none"> Digital differential Analyzer Line Drawing Algorithms Mid-point Circle Generation Algorithm Creating two-Dimensional Objects Two-dimensional Transformation Picture Coloring Three-Dimensional transformation Simple Animation using Transformation Key-Frame Animation Design Animation using FLASH 											

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					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2EC2A	4	Risk Management Framework	EC	5	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of Computer Networks, Information Security concepts, and Operating Systems. 											
Course Objectives: The purpose of learning this course is:											
1. Understand fundamental concepts of risk, threats, and vulnerabilities in information systems.											
2. Learn frameworks and methodologies for effective risk assessment and mitigation.											
3. Gain knowledge of security controls, compliance, and governance models.											
4. Develop skills in continuous risk monitoring and incident response.											
5. Explore enterprise risk management and emerging trends in cybersecurity.											
Course Outcomes:											
CO1: Identify and classify risks in information systems.											
CO2: Perform qualitative and quantitative risk assessments.											
CO3: Apply mitigation strategies and security controls.											
CO4: Implement monitoring, reporting, and governance practices.											
CO5: Analyze enterprise-wide risk management with modern approaches.											
Unit - I	INTRODUCTION TO RISK MANAGEMENT									12Hrs.	
Concept of Risk, Threats, Vulnerabilities, Need for Risk Management in Information Systems, Overview of NIST Risk Management Framework (RMF), Principles of Security, Privacy, and Compliance Risk Management Life Cycle.											
Unit - II	RISK ASSESSMENT									12Hrs.	
Risk Identification: Assets, Threats, and Vulnerabilities, Qualitative vs Quantitative Risk Assessment, Methods: Risk Matrices, Likelihood–Impact Analysis, Tools for Risk Assessment, Documenting Risk Assessment Findings											
Unit - III	RISK MITIGATION AND CONTROLS									12Hrs.	
Risk Response Strategies: Avoidance, Mitigation, Transfer, Acceptance, Security Controls (Administrative, Technical, Physical), Control Frameworks (NIST SP 800-53, ISO/IEC 27001), Implementing Security Policies and Procedures, Case Studies in Risk Mitigation											
Unit - IV	RISK MONITORING AND COMMUNICATION									12Hrs.	
Continuous Monitoring Strategies, Key Risk Indicators (KRIs) and Metrics, Incident Response and Reporting, Communication of Risk to Stakeholders, Role of Governance, Risk, and Compliance (GRC) Tools											
Unit - V	ENTERPRISE RISK MANAGEMENT AND EMERGING TRENDS									12Hrs.	
Enterprise Risk Management (ERM) Framework, Integration of RMF with Business Processes, Cloud and Cybersecurity Risk Management, Legal, Regulatory, and Ethical Issues in Risk Management, Emerging Trends: AI/ML in Risk, Zero Trust Security, Supply Chain Risk											

Text Book(s):

1. James Broad, "Risk Management Framework: A Lab-Based Approach to Securing Information Systems", Syngress/Elsevier, 1st Edition, 2013, ISBN: 9780124058791

Reference Book(s):

1. James Broad, "Risk Management Framework: A Lab-Based Approach to Securing Information Systems", 1st Edition, Syngress/Elsevier, 2013, ISBN: 9780124058791
2. Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", 1st Edition, Syngress, 2011, ISBN: 9781597495929
3. NIST Special Publication 800-53, "Security and Privacy Controls for Federal Information Systems and Organizations", Latest Revision (Free PDF, NIST, 2020 update)
4. Douglas J. Landoll, "The Security Risk Assessment Handbook: A Complete Guide for Performing Security Risk Assessments", 2nd Edition, CRC Press, 2016, ISBN: 9781482245910
5. Anne Lesley Cornish, "Cybersecurity Risk Management: Mastering the Fundamentals Using the NIST Cybersecurity Framework", 1st Edition, Auerbach/CRC Press, 2021, ISBN: 9780367566231

Web Resources:

1. <https://www.iso.org/isoiec-27001-information-security.html>
2. <https://www.enisa.europa.eu/topics/threat-risk-management>
3. <https://www.cisecurity.org/controls>
4. <https://csrc.nist.gov/projects/continuous-monitoring>
5. <https://www.coso.org/Pages/erm.aspx>
6. <https://www.gartner.com/en/information-technology>

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2EC2B	4	Cloud Computing Governance	EC	5	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of Cloud Computing and Information Security. 											
Course Objectives: The purpose of learning this course is:											
1. Understand the fundamentals of cloud computing and governance principles.											
2. Learn risk management, security, and compliance in cloud environments.											
3. Develop cloud policies, control mechanisms, and monitoring strategies.											
4. Gain knowledge of governance tools, frameworks, and cost optimization practices.											
5. Explore emerging trends including multi-cloud, AI/ML, Zero Trust, and sustainability in cloud governance.											
Course Outcomes:											
CO1: Identify cloud service models and governance principles.											
CO2: Assess cloud security risks and ensure regulatory compliance.											
CO3: Design and implement cloud policies, IAM, and data governance controls.											
CO4: Apply governance frameworks and GRC tools for operational efficiency.											
CO5: Analyze emerging trends and implement best practices in cloud governance.											
Unit - I	INTRODUCTION TO CLOUD GOVERNANCE								12Hrs.		
Basics of Cloud Computing & Service Models (IaaS, PaaS, SaaS), Need for Governance in Cloud Environments, Governance Principles: Accountability, Transparency, Compliance, Overview of Cloud Governance Frameworks (COBIT, ITIL, ISO/IEC 38500)											
Unit - II	RISK, SECURITY, AND COMPLIANCE IN CLOUD								12Hrs.		
Cloud Security Challenges and Shared Responsibility Model, Risk Management Frameworks in Cloud (NIST RMF, CSA CCM),Data Privacy and Protection in the Cloud ,Regulatory Compliance: GDPR, HIPAA, ISO/IEC 27017											
Unit - III	CLOUD POLICIES AND CONTROL MECHANISMS								12Hrs.		
Policy Development for Cloud Usage, Identity and Access Management (IAM),Data Governance, Classification, and Encryption Cloud Control Mechanisms: Monitoring, SLAs, and Audits											
Unit - IV	GOVERNANCE Tools and Frameworks								12Hrs.		
Cloud Governance Models and Best Practices, Governance, Risk, and Compliance (GRC) Tools, Cost Governance: Budgeting, Monitoring, and Optimization, Case Studies on Cloud Governance Implementation											
Unit - V	EMERGING TRENDS IN CLOUD GOVERNANCE								12Hrs.		
Multi-cloud and Hybrid Governance Models, AI/ML for Cloud Compliance and Risk Prediction, Zero Trust Security in Cloud Governance, Future Directions: Cloud Sustainability and Ethical Issues											

Text Book(s):

1. Rhoton, John. "Cloud Computing Explained: Implementation Handbook for Enterprises." 2nd Edition, Recursive Press, 2021. ISBN: 978-0956355617.

Reference Book(s):

1. Erl, Thomas, Zaigham Mahmood, and Ricardo Puttini. "Cloud Computing: Concepts, Technology & Architecture." 1st Edition, Pearson Education, 2013. ISBN: 9780133387520.
2. Mather, Tim, Subra Kumaraswamy, and Shahed Latif. "Cloud Security and Privacy." O'Reilly Media, 2009. ISBN: 9780596802769.
3. Chandramouli, Ramaswamy. "Identity and Access Management in Cloud." NIST SP 1800-2, 2017.
4. Calder, Alan. "IT Governance: An International Guide to Data Security and ISO27001/ISO27002." 6th Edition, Kogan Page, 2020. ISBN: 9781789662299.
5. Sriram, Ilango, and Ali Khajeh-Hosseini. "Research Agenda in Cloud Technologies and Governance." University of St. Andrews, 2016.

Web Resources:

1. <https://www.nist.gov/programs-projects/cloud-computing>
2. <https://csrc.nist.gov/projects/risk-management>
3. <https://cloudsecurityalliance.org/artifacts>
4. <https://www.isaca.org/resources>
5. <https://learn.microsoft.com/en-us/azure/architecture>

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2EC2C	4	Artificial Intelligence for Risk Management	EC	5	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of Artificial Intelligence, Machine Learning, and Information Security concepts. 											
Course Objectives: The purpose of learning this course is:											
1. Understand basic concepts of AI and its applications in risk management.											
2. Learn techniques for risk assessment using AI and predictive analytics.											
3. Develop AI-driven strategies for risk mitigation and decision-making.											
4. Explore AI applications in cybersecurity, compliance, and regulatory risk.											
5. Examine emerging trends, ethical considerations, and governance in AI for risk management											
Course Outcomes:											
CO1: Identify types of risks and apply AI concepts for risk evaluation.											
CO2: Perform AI-based risk assessment and predictive modeling.											
CO3: Design AI-assisted mitigation strategies and decision support systems.											
CO4: Apply AI in cybersecurity and compliance risk management.											
CO5: Analyze emerging AI trends, ethical implications, and governance in risk management.											
Unit - I	INTRODUCTION TO AI AND RISK MANAGEMENT								12Hrs.		
Basics of Artificial Intelligence: Definition, Applications, and Types, Overview of Risk in Organizations: Operational, Financial, Cyber security, Role of AI in Identifying and Understanding Risks, Introduction to AI-based Risk Management Frameworks											
Unit - II	AI TECHNIQUES FOR RISK ASSESSMENT								12Hrs.		
Introduction to Machine Learning: Supervised, Unsupervised, and Reinforcement Learning, Predictive Analytics for Risk Scoring, Comparing Statistical Models and AI Models for Risk, Beginner Case Studies: AI in Credit, Market, and Operational Risk											
Unit - III	AI FOR RISK MITIGATION AND DECISION MAKING								12Hrs.		
AI-assisted Risk Mitigation Strategies, Decision Support Systems for Risk Management, Simple Optimization Techniques using AI (Genetic Algorithms, Basic Reinforcement Learning), Scenario Analysis and Stress Testing											
Unit - IV	AI IN CYBERSECURITY AND COMPLIANCE RISK								12Hrs.		
AI for Threat Detection and Fraud Prevention, Cyber Risk Monitoring using AI, Compliance Automation for Regulations (GDPR, HIPAA), Beginner-Friendly Tools for AI-enabled Risk Monitoring											
Unit - V	EMERGING TRENDS IN AI FOR RISK MANAGEMENT								12Hrs.		
AI in Enterprise Risk Management (ERM), Predictive Analytics for Operational, Financial, and Supply Chain Risks, Introduction to Explainable AI (XAI) for Transparency, Ethical Considerations and Beginner-Level AI Governance											

Text Book(s):

1. Russell, Stuart, and Peter Norvig. Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021, ISBN: 9780134610993
2. Baesens, Bart. Analytics in a Big Data World: Essential Guide to Data Science, 2nd Edition, Wiley, 2014, ISBN: 9781118899528
3. Provost, Foster, and Tom Fawcett. Data Science for Business, 2nd Edition, O'Reilly, 2021, ISBN: 9781098113985
4. Chio, Carla, and David Freeman. Machine Learning and Security, 1st Edition, O'Reilly, 2018, ISBN: 9781491979904
5. Kroll, Joshua, et al. Accountable Algorithms, 1st Edition, Routledge, 2020, ISBN: 9780367339211

Reference Book(s):

1. Hopkin, Paul. Fundamentals of Risk Management, 5th Edition, Kogan Page, 2018, ISBN: 9780749482395
2. Powers, David. Introduction to Machine Learning for Risk Analysis, 1st Edition, Springer, 2020, ISBN: 9783030456789
3. Harrington, J. Risk Management and Simulation, 2nd Edition, Wiley, 2015, ISBN: 9781118892269
4. Sommer, Peter. Artificial Intelligence in Cybersecurity, Springer, 2020, ISBN: 9783030345678
5. Fraser, Nigel. Artificial Intelligence in Enterprise Risk Management, 1st Edition, Routledge, 2021, ISBN: 978036750123

Web Resources:

1. <https://www.media.mit.edu/projects/ai-ethics>
2. <https://www.cisa.gov/cybersecurity>
3. <https://www.ibm.com/cloud/learn/ai-risk-management>
4. https://www.sas.com/en_us/insights/analytics/predictive-analytics.html
5. <https://www.rims.org/resources>

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2EC2D	4	Soft Computing	EC	5	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of Mathematics, Algorithms, and Programming fundamentals. 											
Course Objectives: The purpose of learning this course is:											
1. To introduce the principles and constituents of Soft Computing.											
2. To study Artificial Neural Networks and their learning models.											
3. To understand fuzzy set theory, fuzzy logic, and reasoning.											
4. To explore Genetic Algorithms and their applications.											
5. To apply Soft Computing techniques in solving real-world problems.											
Course Outcomes:											
CO1: Differentiate between hard and soft computing techniques.											
CO2: Design and implement ANN models for classification and prediction.											
CO3: Apply fuzzy sets, relations, and inference methods for decision-making.											
CO4: Utilize fuzzy logic systems and expert systems in control applications.											
CO5: Develop optimization solutions using Genetic Algorithms.											
Unit - I INTRODUCTION									12Hrs.		
Soft Computing Constituents – Soft Computing Vs Hard Computing – Characteristics - Applications - Artificial Neural Network (ANN):Fundamental Concept – Application Scope - Basic Terminologies – NeuralNetwork Architecture – Learning Process – Basic Models of ANN: McCulloch-PittsModel – Hebb Network – Linear Separability.											
Unit - II SUPERVISED LEARNING NETWORKS:									12Hrs.		
Perceptron Networks – Adaline and Madaline Networks – Back Propagation Network – Radial Basis Function Network.Associative Memory Networks – BAM - Hopfield Network - Boltzmann Machine. Unsupervised Learning Networks: Kohonen Self Organizing Network – Counter Propagation Network – ART Network.											
Unit - III FUZZY SETS:									12Hrs.		
Basic Concept – Crisp Set Vs Fuzzy Set - Operations on Fuzzy Set –Properties of Fuzzy Sets – Fuzzy Relations: Concept – Fuzzy Composition – Fuzzy Equivalence and Tolerance Relation - Membership Functions: Features – Fuzzification – Methods of Membership value assignments – Defuzzification –Methods.											
Unit - IV FUZZY ARITHMETIC									12Hrs.		
Extension Principle – Fuzzy Measures – Fuzzy Rules andFuzzy Reasoning: Fuzzy Propositions – Formation of Rules – Decomposition ofRules – Aggregation of Rules – Approximate Reasoning – Fuzzy Inference andExpert Systems – Fuzzy Decision Making – Fuzzy Logic Control Systems.											
Unit - V GENETIC ALGORITHMS:									12Hrs.		
Fundamental Concept – Basic Terminologies – Traditional Vs Genetic Algorithm - Elements of GA - Encoding - Fitness Function – Genetic Operators: Selection – Cross Over - Inversion and Deletion - Mutation – Simpleand General GA – The Schema Theorem - Classification of Genetic Algorithm –Genetic Programming – Applications of GA.											

Text Book(s):

1. S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing”, Wiley India,2007.
[Unit – I] [Unit – II] [Unit – III] [Unit – IV] [Unit – V]

Reference Book(s):

1. Snehashish Chakraverty, Arup Kumar Sahoo, Dhableswar Mohapatra, “Artificial Neural Networks and Type-2 Fuzzy Set: Elements of Soft Computing and Its Applications”, 1st Edition, Elsevier, 2025, ISBN: 9780443328947
2. Snehashish Chakraverty, Arup Kumar Sahoo, Dhableswar Mohapatra, “Artificial Neural Networks and Type-2 Fuzzy Set: Elements of Soft Computing and Its Applications”, 1st Edition, Elsevier, 2025, ISBN: 9780443328947
3. Snehashish Chakraverty, Arup Kumar Sahoo, Dhableswar Mohapatra, “Artificial Neural Networks and Type-2 Fuzzy Set: Elements of Soft Computing and Its Applications”, 1st Edition, Elsevier, 2025, ISBN: 9780443328947
4. Snehashish Chakraverty, Arup Kumar Sahoo, Dhableswar Mohapatra, “Artificial Neural Networks and Type-2 Fuzzy Set: Elements of Soft Computing and Its Applications”, 1st Edition, Elsevier, 2025, ISBN: 9780443328947
5. Snehashish Chakraverty, Arup Kumar Sahoo, Dhableswar Mohapatra, “Artificial Neural Networks and Type-2 Fuzzy Set: Elements of Soft Computing and Its Applications”, 1st Edition, Elsevier, 2025, ISBN: 9780443328947

Web Resources:

1. <https://www.javatpoint.com/soft-computing>
2. https://www.tutorialspoint.com/fuzzy_logic/index.html
3. <https://www.guru99.com/what-is-fuzzy-logic.html>

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2NME1	2	Fundamentals Of Information Technology	NME	2	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> • Basic understanding of computers and general awareness of the Internet. 											
Course Objectives: The purpose of learning this course is:											
1. Introduce fundamental concepts of Information Technology and its applications.											
2. Provide knowledge of computer basics, types, characteristics, and memory.											
3. Explain software categories, system software, and application software.											
4. Describe computer networks, types, topologies, and related technologies.											
5. Familiarize students with basic Internet concepts, tools, and communication methods.											
Course Outcomes:											
CO1: Describe the role of IT in various fields such as business, education, science, and entertainment.											
CO2: Explain the history, classification, and characteristics of computers along with memory types.											
CO3: Identify different types of application and system software and their functions.											
CO4: Explain computer network types, topologies, and related concepts like intranet and firewalls.											
CO5: Demonstrate understanding of basic Internet concepts, browsing, and communication tools.											
Unit - I	INFORMATION TECHNOLOGY									12Hrs.	
Introduction – Information systems – Definition of computer and system – Software and Data - IT in business and Industry – IT in the Home and at Play – IT in Education and Training – IT in Entertainment and the Arts – IT in Science, Engineering, and Mathematics – Global Positioning System.											
Unit - II	INTRODUCTION TO COMPUTERS									12Hrs.	
Introduction- History of computers, Types of computers, Characteristics of computers, Basic Anatomy of a computer, Applications of computer – Memory – Memory types.											
Unit - III	SOFTWARE									12Hrs.	
Kinds of Software - The five types of Applications software – Word processing – Spreadsheets - Database software, Presentation graphics software - Communications software System Software – Operating system – functions.											
Unit - IV	COMPUTER NETWORKS									12Hrs.	
Introduction – Definition Computer Networks - Types of Networks – Local Area Network – Metropolitan Area Network - Wide Area Network – Personal Area Network - internet – Intranet – firewalls - Network Topology – Bus – Ring – Hybrid – Star											
Unit - V	BASIC INTERNET CONCEPTS									12Hrs.	
Analog and Digital Signals - modems and communication Software, ISDN lines, and Cable Modems - Definition of Internet - The World Wide Web - Connecting to the Internet – Browsing the web – Web browser – Uniform Resource Locator (URL) – E-mail communication.											

Text Book(s):

1. Dennis P.Curtin, Kimdolwy, KunLAWN, Xrhleen morin, “InformationTechnology”, the breaking wave, TMH 2000. [Unit I] [Unit III]
2. Stacey C Sawyer, Brain K Williams, Sarah E Hutchinson “Using InformationTechnology” –Brief Version. [Unit II]
3. “A Practical Introduction to Computer and Communications” Third Edition, McGraw Hill Companies 2011. [Unit IV]
4. The Internet Book: “Everything You Need to Know About Computer Networking and How the Internet Works”, Douglas E. Comer, Pearson, 2000. [Unit V]

Reference Book(s):

1. R. Kelly Rainer, Introduction to Information Systems, 8th Edition, Wiley, 2020.
2. Anita Goel, Computer Fundamentals, 2nd Edition, Pearson, 2020.
3. Behrouz A. Forouzan, Foundations of Computer Science: From Data Manipulation to Networking, 2nd Edition, Cengage, 2021.
4. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks, 6th Edition, Pearson, 2022.
5. Olivier Bonaventure, Computer Networking: Principles, Protocols and Practice, 2nd Edition, 2020

Web Resources:

1. <https://www.javatpoint.com/internet>
2. <http://www.steves-internet-guide.com/networking/>

Prepared by
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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2BC4	4	Web Design	BC	-	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of computers, internet concepts, and fundamental programming skills. 											
Course Objectives: The purpose of learning this course is:											
1. Understand networking concepts, internet architecture, protocols, and addressing schemes.											
2. Learn the fundamentals of HTML for creating structured web pages.											
3. Develop skills to design and format web pages using HTML tables, links, frames, and forms.											
4. Gain knowledge of JavaScript fundamentals for client-side web interactivity.											
5. Apply JavaScript DOM manipulation techniques for dynamic and event-driven web applications.											
Course Outcomes:											
CO1: Explain internet concepts, protocols, addressing methods, and client-server communication.											
CO2: Create web pages using HTML structure, tags, and special characters.											
CO3: Design and implement tables, hyperlinks, frames, and forms in HTML.											
CO4: Write JavaScript programs for basic computations, conditions, loops, and functions.											
CO5: Implement DOM manipulation, event handling, and cookies in interactive web pages.											
Unit - I	NETWORKING CONCEPTS									6 Hrs.	
INTERNET - History - Applications-Users – Protocols -Host Machines and Host Names - Internet Architecture and Packet Switching-Client Server Model - Band width and Asynchronous Communication.Connection: Dial-up Access-Direct and Dedicated Connections - shell or TCP/ IPaccounts - Domains and Addresses – IP addresses.											
Unit - II	HTML									6 Hrs.	
Introduction to HTML Tags - Document Layout - Comments - Headings-Paragraphs -Breaks - Texts - Lists - Special Characters.											
Unit - III	HTML									6 Hrs.	
Tables - Linking documents - Frames - Form and its elements.											
Unit - IV	JAVASCRIPT									6 Hrs.	
Introduction to JavaScript - JavaScript in web pages-writingJavaScript with HTML - Basic programming techniques - operators and expressions - conditional checking - loops - functions - user defined functions -dialog boxes.											
Unit - V	JAVASCRIPT									6 Hrs.	
JavaScript: JavaScript DOM: JSS DOM - understanding objects in HTML -browser objects - web page object hierarchy - Handling events - The form object -built-in objects-user defined objects - cookies - Setting a cookie.											

Text Book(s):

1. Wendy G. Lehnert, "Internet 101 - A Beginners Guide To The Internet And TheWorld Wide Web", Addison-Wesley, 1999. [Unit I]
2. Ivan N. Bayross, "Web enabled Commercial Application Development usingHTML, JavaScript, DHTML and PHP", 4th Revised Edition, BPB Publications,New Delhi, 2010. [Unit II] [Unit III] [Unit IV]
3. John Pollock, "JavaScript A Beginner's Guide", The McGraw-Hill, 2010.[Unit V]

Reference Book(s):

1. Behrouz A. Forouzan, Data Communications and Networking, 6th Edition, McGraw Hill, 2021.
2. Jon Duckett, HTML and CSS: Design and Build Websites, 2nd Edition, Wiley, 2022.
3. Ben Frain, Responsive Web Design with HTML5 and CSS, 4th Edition, Packt, 2022.
4. David Flanagan, JavaScript: The Definitive Guide, 7th Edition, O'Reilly, 2020.
5. Florian Rapp, Modern JavaScript for the Impatient, Addison-Wesley, 2022.

Web Resources:

1. <https://www.w3schools.com/>
2. <https://javascript.info/>

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HoD

Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tut. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2BC5	4	Digital Electronics	BC	-	-	-	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of electronics and mathematics, including binary and arithmetic operations. 											
Course Objectives: The purpose of learning this course is:											
1. Understand IC logic families and their characteristics, including TTL, ECL, and CMOS.											
2. Learn fundamental digital principles, number systems, codes, and binary arithmetic operations.											
3. Study Boolean algebra, logic gates, De Morgan's theorems, and universal gates.											
4. Design combinational logic circuits such as half adders and full adders.											
5. Understand sequential logic circuits, flip-flops, triggering methods, and their applications.											
Course Outcomes:											
CO1: Explain IC logic families, tri-state logic, and advantages of ICs over discrete components.											
CO2: Apply digital principles including number systems, binary arithmetic, and coding schemes like ASCII and Gray code.											
CO3: Analyze and simplify Boolean expressions and implement logic gates using universal gates.											
CO4: Design and implement combinational logic circuits including half and full adders.											
CO5: Understand and implement sequential logic circuits, including RS and JK flip-flops with triggering mechanisms.											
Unit - I IC LOGIC FAMILIES									6 Hrs.		
IC logic families- definition. General characteristics- TTL, ECL and CMOS, advantages and disadvantages, Definition- Tri-state logic. IC definition, advantages of IC over discrete components.											
Unit - II DIGITAL PRINCIPLES									6 Hrs.		
Definitions- bit, nibble, byte, word, and parity bit. Number system definition, types, radix, decimal, BCD, binary and hexadecimal. BCD addition. Binary addition, subtraction, Multiplication, Division, 1's and 2's complement. Hexadecimal addition, subtraction, advantages. Conversion decimal to binary and hexadecimal and vice versa. ASCII, Gray codes, and list applications.											
Unit - III BOOLEAN ALGEBRA & LOGIC GATES									6 Hrs.		
Definition- Boolean variable, complement, Boolean function, expression, truth table and Buffer. Boolean Algebra- rules and laws. Logic gates NOT, AND, OR, NAND, NOR, EX-OR- definition, symbol, Boolean equation, truth table and working. De Morgan's theorems- statement and equations. Universal gates- definition, realisation of NOT, OR, AND and EXOR gates.											
Unit - IV COMBINATIONAL LOGIC CIRCUITS									6 Hrs.		
Definition. Adders- definition, types. Half adder block diagram, logic diagram using AND and XOR, truth table and working. Full adder- block diagram, logic diagram using AND, OR and XOR, truth table and working.											
Unit - V SEQUENTIAL LOGIC CIRCUITS									6 Hrs.		
Definitions- level and edge triggering. Flip flops definition, types and applications. RS flip flop and clocked RS flip flop- block diagram, truth table, logic diagram using NAND gates and working. JK flip flop block diagram, truth table, logic diagram using NAND gates and working.											

Text Book(s):

1. “Digital Fundamentals” by T. L. Floyd, Pearson International Publications, Ninth Edition, 2000. [Unit I] [Unit II] [Unit IV]
2. “Modern Digital Electronics” by R P Jain, Tata McGraw-Hill Education, 2003. [Unit I]
3. “Principles of Digital Electronics” By K. Meena, PHI Learning Pvt. Ltd, New Delhi, 2009. [Unit II]
4. “Digital Electronics: Principles and Applications” by R. L. Tokheim, Tata McGraw-Hill Education, 2013. [Unit III]
5. “Electronics Principles by Malvino and Leach”, Mc. Graw Hill, Third edition, 2000. [Unit V]

Reference Book(s):

1. Ronald J. Tocci, Neal S. Widmer & Gregory L. Moss, Digital Systems: Principles and Applications, 11th Edition, Pearson, 2016.
2. Donald P. Leach, Albert Paul Malvino & Goutam Saha, Digital Principles and Applications, 8th Edition, McGraw Hill, 2015.

Web Resources:

1. Anil K. Maini, Digital Electronics: Principles, Devices and Applications, 2nd Edition, Wiley, 2019.
2. Charles H. Roth & Larry L. Kinney, Fundamentals of Logic Design, Cengage, 7th Edition, 2021.
3. M. Morris Mano & Michael Ciletti, Digital Design, Pearson, 6th Edition, 2018.
4. Stephen Brown & Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, McGraw Hill, 3rd Edition, 2020.
5. Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson, 2021.

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Sem.	Course Code	Credits	Title of the Course	CC / AC / DE / SE / GS / EVS/VE / VAC	Category			Sem. Exam	Category		
					Lect. Hrs.	Tuto. Hrs.	Lab. Hrs.		CIA	ESE	Total
II	25PCA2BCP2	2	Web Design Lab	BCP	-	-	3	3 Hrs.	25	75	100
Pre-Requisite:											
<ul style="list-style-type: none"> Basic knowledge of HTML, web browsers, and elementary programming concepts. 											
Course Objectives: The purpose of learning this course is:											
1. Learn text formatting and string manipulation in web pages.											
2. Display structured information using tables and frames.											
3. Design interactive forms for user input.											
4. Implement event handling for dynamic web behavior.											
5. Create and manage cookies for client-side data storage.											
Course Outcomes:											
CO1: Apply text formatting and string operations in HTML and JavaScript.											
CO2: Apply text formatting and string operations in HTML and JavaScript.											
CO3: Design forms for data collection and user interaction.											
CO4: Implement event handling for responsive web pages.											
CO5: Create, manage, and utilize cookies in web applications.											
List of Practical										45 Hrs.	
<ol style="list-style-type: none"> Text formatting Getting input and performing string manipulation operations. Using tables for neatly displaying information about an organization. Using frames to categories and display information in a easy-to-understand format. Using forms to create web pages for applying for a position in an organization. Event handling Creating and managing cookies. 											

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