School of Computer Applications

Curriculum Structure for Bachelor of Computer Applications (BCA)

A.Y. 2023-24 (R23)

Third Year Semester V

Course code	Course name	Teaching scheme (Hrs/week)			Credits assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U16PC501	Introduction to Artificial Intelligence	3	-	-	3	-	-	3
U16PC502	Data Structures	3	-	-	3	-	-	3
UXXOE05X	Open Elective V	2	-	-	2	-	-	2
UXXMM0XX	Multidisciplinary Minor IV	3	-	-	3	-	-	3
U16PE5XX	Program Elective I	3	-	-	3	-	-	3
U16VS504	UI/UX Design	-	4	-	-	2	-	2
U16PC503	Introduction to Artificial Intelligence Lab	-	2	-	-	1	-	1
U16PC504	Data Structures Lab	-	2	-	-	1	-	1
UXXMM0XX	Multidisciplinary Minor IV Lab	-	2	-	-	1	-	1
U16PE5XX	Program Elective I Lab	-	2	-	-	1	-	1
U16FP002	Field Project II	-	4	-	-	2	-	2
Total		**14**	**16**	**-**	**14**	**8**	**-**	**22**

* Out of 2 hours, 1-hour theory shall be taught to entire class followed by 1hrs. Practical in batches,

Th: Theory, Pr: Practical, Tu: Tutorial

School of Computer Applications

Curriculum Structure for Bachelor of Computer Applications (BCA)

A.Y. 2023-24 (R23)

Third Year Semester V: Evaluation Scheme

Course code	Course name	*Theory Marks*					*Practical Marks*		Total
		Internal Assessment				ESE	Term work/ *Tutorial*	Practical/ POE	
		T1	T2	FET	Total				
U16PC501	Introduction to Artificial Intelligence	10	10	5	25	50	-	-	75
U16PC502	Data Structures	10	10	5	25	50	-	-	75
UXXOE05X	Open Elective V	-	10	5	15	35			50
UXXMM0XX	Multidisciplinary Minor IV	10	10	5	25	50	-	-	75
U16PE5XX	Program Elective I	10	10	5	25	50	-	-	75
U16VS504	UI/UX Design	-	-	-	-	-	25	25	50
U16PC503	Introduction to Artificial Intelligence Lab	-	-	-	-	-	25	-	25
U16PC504	Data Structures Lab	-	-	-	-	-	25	-	25
UXXMM0XX	Multidisciplinary Minor IV Lab	-	-	-	-	-	25	-	25
U16PE5XX	Program Elective I Lab	-	-	-	-	-	25	-	25
U16FP002	Field Project II	-	-	-	-	-	25	25	50

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course

School of Computer Applications

Curriculum Structure for Bachelor of Computer Applications (BCA)

A.Y. 2023-24 (R23)

Third Year Semester VI

Course code	Course name	Teaching scheme (Hrs/week)			Credits Assigned			Total credits
		Th	Pr	Tu	Th	Pr	Tu	
U16PC601	Advanced Application Development	3	-	-	3	-	-	3
U16PC602	C# Programming	3	-	-	3	-	-	3
UXXOE06X	Open Elective VI	2	-	-	2	-	-	2
UXXMM0XX	Multidisciplinary Minor V	3	-	-	3	-	-	3
U16PE6XX	Program Elective II	3	-	-	3	-	-	3
U16PC603	Advanced Application Development Lab	-	2	-	-	1	-	1
U16PC604	C# Programming Lab	-	2	-	-	1	-	1
UXXMM0XX	Multidisciplinary Minor IV Lab		2	-	-	1	-	1
U16PE6XX	Program Elective II Lab	-	2	-	-	1	-	1
U16OT601	Industrial Internship	-	8	-	-	4	-	4
Total		**14**	**16**	**-**	**14**	**8**	**-**	**22**

- * Out of 2 hours, 1-hour theory shall be taught to entire class followed by 1hrs. Practical in batches, Th: Theory, Pr: Practical, Tu: Tutorial

School of Computer Applications

Curriculum Structure for Bachelor of Computer Applications (BCA)

A.Y. 2023-24 (R23)

Third Year Semester VI: Evaluation Scheme

Course code	Course name	*Theory Marks*					*Practical Marks*		Total
		Internal Assessment				SEE	Term work /*Tutorial*	Practical / POE	
		T1	T2	FET	Total				
U16PC601	Advanced Application Development	10	10	5	25	50	-	-	75
U16PC602	C# Programming	10	10	5	25	50	-	-	75
UXXOE06X	Open Elective VI	-	10	5	15	35	-	-	50
UXXMM0XX	Multidisciplinary Minor V	10	10	5	25	50	-	-	75
U16PE6XX	Program Elective II	10	10	5	25	50	-	-	75
U16PC603	Advanced Application Development Lab	-	-	-	-	-	25	-	25
U16PC604	C# Programming Lab	-	-	-	-	-	25	-	25
UXXMM0XX	Multidisciplinary Minor IV Lab	-	-	-	-	-	25	-	25
U16PE6XX	Program Elective II Lab	-	-	-	-	-	25	-	25
U16OT601	Industrial Internship	-	-	-	-	-	50	50	100

* Minimum passing is 40% for all courses and evaluation head mentioned above. FET – Faculty evaluation for Theory, T1, T2, Continuous Assessment Test, Term Work, ESE - End Semester Examination, P/F – Pass/ Fail Course, AU – Audit Course

School of Computer Applications

Curriculum Structure for Bachelor of Computer Applications (BCA)

A.Y. 2023-24 (R23)

**Pool of Major Electives

Program Elective –I	
U16PE501	Unstructured Database
U16PE502	Advanced Java
U16PE503	Introduction to Cloud Computing
Program Elective –II	
U16PE601	Cyber Security
U16PE602	Data Mining and Warehousing
U16PE603	Internet of Things
Program Elective –III	
U16PE701	Open-Source Technologies
U16PE702	Big Data Analytics
U16PE703	Introduction to AWS
Program Elective –IV	
U16PE801	Block Chain Technology
U16PE802	Ethical Hacking
U16PE803	Cloud Application Development

School of Computer Applications

Curriculum Structure for Bachelor of Computer Applications (BCA)
A.Y. 2023-24 (R23)

Open Elective for UG program

Sr. No.	Semester	Course Code	Course Name	Credits
1	I	U16OE011	MS Office & Latex	2
2	II	U16OE021	Python Programming	2
3	III	U16OE031	Data Analytics Tools	2
4	IV	U16OE041	Web Designing Tools	2
5	V	U16OE051	Data Visualization Techniques using Tableau	2
6	VI	U16OE061	Multimedia Computing	2
Total Credits 12				

School of Computer Applications

Curriculum Structure for Bachelor of Computer Applications (BCA)

A.Y. 2023-24 (R23)

Multi-Disciplinary Minor Track –Data Science and Analytics

Semester	Course Code	Course Name	Credits
II	U16MM011	Basics of Data Science	2
III	U16MM021	Statistical Computing	3
	U16MM022	Statistical Computing Lab	1
IV	U16MM031	Python for Data Science	3
	U16MM032	Python for Data Science Lab	1
V	U16MM041	Foundation Skills of Machine Learning	3
	U16MM042	Foundation Skills of Machine Learning Lab	1
VI	U16MM051	Predictive Modeling and Analytics	3
	U16MM052	Predictive Modeling and Analytics Lab	1

SEMESTER V

Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PC501	Introduction to Artificial Intelligence	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PC501	Introduction to Artificial Intelligence	T1	T2	FE T	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:
This course provides an introduction to artificial intelligence. This course covers core topics of knowledge representation, reasoning, and learning, heuristic search techniques and expert systems.

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Pre-requisites: - Basic programming skills in a language such as C, C++ or Java.

Course Objectives:

1.	To learn the advantages, disadvantages, challenges and search algorithm of AI
2.	To elaborate knowledge representation system
3.	To understand basic concepts of ANN
4.	To explore Genetic algorithm.

Course Outcomes: after the end of this course students will able to

CO1	**Apply**[3] problem solving by intelligent search approach.
CO2	**Represent**[4] knowledge using knowledge representation techniques
CO3	**Discuss**[2] working of Artificial Neural Networks.
CO4	**Apply**[3] solutions for problems with uncertainty using Fuzzy theory.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction of AI and Problem Solving**	
1	1.1	Artificial Intelligence, AI Problems, AI Techniques, Defining the Problem as a State Space Search, uninformed search and informed search	9
	1.2	Heuristic search, hill climbing, Best first search, A* algorithm, AO* algorithm, constraint satisfaction, Game playing: Minmax search procedure, Alpha –Beta pruning	
2.0		**Knowledge Representation**	
2	2.1	Introduction, Propositional Logic, Syntax and Semantics, Interpretations, Properties, Predicate logic, WFF, Free and Bound Variables,	9
	2.2	Normal Forms, Inference Techniques, Resolution, Unification, Modes Pones, Frames, Frame Representation Language, Semantic Net, Forward and Backward Reasoning	
3.0		**Propositional and Predicate logic:**	
3	3.1	Introduction, Propositional Logic, Syntax and Semantics, Interpretations, Properties, Predicate logic, WFF, Free and Bound Variables.	9
4.0		**Introduction to deep Learning and fuzzy logic**	
4	4.1	Introduction to deep learning and deep neural network. Fuzzy Set Theory, Fuzzy Membership, Fuzzy Operations, Fuzzy Logic Systems.	9
5.0		**Natural Language Processing:**	
5	5.1	Introduction, Phases of NLP, advantages, disadvantages, applications. Genetic Algorithm: Genetic Algorithm (GA), Genetic Representations,	9

		Initialization and Selection, Different Operators of GA, Analysis of Selection Operations, the Hypothesis of Building Blocks, Introduction to Expert System.	

References:

1. Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw Hill
2. Nils J Nilson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann Publishers , Inc., San Francisco, California, 2000.
3. Saroj Kaushik , Artificial Intelligence, Cengage Learning
4. B. Yegnanarayana, Artificial Neural Networks, Prentice-Hall of India
5. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, S. Rajasekaran, G. A. Vijayalakshmi Pai, Prentice-Hall of India, 2003
6. Artificial Intelligence: A Modern Approach, 2nd edition, by Russell and Norvig, Prentice Hall

- **Internal Assessment (T1, T2 and FET):**

  T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each. Fifth module will be assessed for 5 marks separately.

- **Semester End Examination:**
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 2 /3/ 4 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PC502	Data Structures	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PC502	Data Structures	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:

This course provides a thorough exploration of both linear and non-linear data structures, their operations, and applications. Students will learn about fundamental concepts such as arrays, linked lists, stacks, queues, trees, graphs, and advanced data structures such as hashing and tries. The course emphasizes the importance of performance analysis, algorithm complexity, and real-world applications in problem-solving. Additionally, students will be introduced to contemporary trends in data structures, including their relevance in big data and machine learning contexts. Practical exercises and implementations will reinforce theoretical knowledge, preparing students for software development and data management challenges.

Pre-requisite: - Basic programming skills in a language such as C, C++ or Java.

Course Objectives:

1.	To understand the fundamental concepts of data structures and their significance in software development.
2.	To learn about various linear and non-linear data structures and their operations.
3.	To explore advanced data structures and their applications in solving complex problems.
4.	To apply algorithms related to searching, sorting, and problem-solving techniques in real-world scenarios.

Course Outcomes: after the end of this course students will able to

CO1	**Identify**[2] and implement appropriate data structures for various computational problems.
CO2	**Demonstrate**[3] proficiency in performing operations on linear and non-linear data structures.
CO3	**Apply**[3] advanced data structures such as hashing, tries, and trees in practical applications.
CO4	**Evaluate**[6] algorithm efficiency and solve complex problems using appropriate strategies like dynamic programming and greedy methods.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Data Structures**	
1	1.1	Definition and Importance of Data Structures, Types of Data Structures, Primitive Data Structures, Non-Primitive Data Structures, Abstract Data Types (ADTs), Operations on Data Structures	9
	1.2	Performance Analysis of Algorithms, Time Complexity, Space Complexity, Big O Notation, Big Ω (Omega), and Big Θ (Theta).	
2.0		**Linear Data Structures**	
2	2.1	Array Operations (Insertion, Deletion, Traversal),Linked Lists- Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists, Operations on Linked Lists	9
	2.2	Stacks, Stack Operations (Push, Pop, Peek),Applications of Stacks (Expression Evaluation, Backtracking), Queues- Linear Queue, Circular Queue, Priority Queue, Queue Operations (Enqueue, Dequeue)	
3.0		**Non-Linear Data Structures**	
3	3.1	Trees-Terminology and Basic Concepts, Binary Trees, Binary Search Trees (BST), AVL Trees and Balancing Trees, Tree Traversal (In-order, Pre-order, Post-order)	9
	3.2	Heaps- Introduction to Heaps, Binary Heap (Max Heap and Min Heap) Heap Operations (Insertion, Deletion), Graphs, Representation of Graphs (Adjacency Matrix, Adjacency List), Graph Traversal Algorithms (DFS, BFS)	
4.0		**Advanced Data Structures**	
4	4.1	Hash Functions, Collision Resolution Techniques (Chaining, Open Addressing) Tries- Trie Structure, Applications of Tries (Auto-Completion, Spell Check), Segment Trees, Introduction and Applications.	9

	4.2	Disjoint Set Data Structure, Union-Find Algorithm, Path Compression, B-Trees and B+ Trees, B-Trees, B+ Trees, Applications in Databases	
5.0		**Applications of Data Structures and Algorithms**	
5	5.1	Sorting Algorithms-Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort Time and Space Complexity Analysis, Searching Algorithms- Linear Search, Binary Search	9
	5.2	Search Algorithms in Graphs (Dijkstra's Algorithm, A* Algorithm), Problem-Solving Techniques- Greedy Method, Divide and Conquer, Dynamic Programming	
	5.3	Current Trends in Data Structures-Big Data and Data Structures, Data Structures in Machine Learning	

References:

1. "Data Structures and Algorithms in C++" by Adam Drozdek
2. Data Structures and Algorithms Made Easy" by Narasimha Karumanchi
3. Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
4. "Data Structures using C" by Reema Thareja
5. "Algorithms, Part I and Part II" by Robert Sedgewick and Kevin Wayne
6. "Data Structures and Algorithm Analysis in C" by Mark Allen Weiss.

- **Internal Assessment (T1, T2 and FET):**

  T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each. Fifth module will be assessed for 5 marks separately.

- **Semester End Examination:**
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 2 /3/ 4 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U16OE051	**Data Visualization Techniques using Tableau**	02	-	-	02	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U16OE051	**Data Visualization Techniques using Tableau**	-	10	5	15	40%	35	40%	50

Course Description:
This course introduces the fundamental concepts and practical skills of data visualization using Tableau, a leading data visualization tool. Designed for students from non-computer science backgrounds, the course emphasizes hands-on learning and visual storytelling through intuitive and engaging visual analytics. Students will learn how to connect to data, clean and prepare datasets; build a variety of charts and dashboards, and present data-driven insights effectively. By the end of the course, students will be able to transform raw data into meaningful visualizations and narratives that support decision-making in diverse fields.

Pre-requisites: Data Visualizations, Basics of Graphs

Course Objectives:

1.	To Explain the fundamentals of data visualization.
2.	To familiarize students with Tableau as a tool for creating impactful visualizations.
3.	To enable students to analyze, interpret, and present data meaningfully..
4.	To apply basic data storytelling and dashboard creation techniques.

Course Outcomes: after the end of this course students will be able to

CO1	**Understand**[2] the role and importance of data visualization in data analysis and decision-making.

CO2	**Demonstrate**[4] the ability to connect Tableau to various data sources and perform basic data preparation tasks.
CO3	**Create**[6] common types of visualizations such as bar charts, line graphs, maps, and scatter plots using Tableau.
CO4	**Apply**[3] visualization techniques to real-world datasets and present findings through a capstone project using Tableau.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Data Visualization and Tableau**	
		• Importance of Data Visualization • Principles of Good Visual Design • Overview of Tableau and its Features • Installing Tableau Public/Desktop • Tableau Interface and Workflow Basics	6
2.0		**Working with Data in Tableau**	
		• Dimensions vs. Measures • Data Types and Data Preparation • Data Cleaning and Transformation (Basic Level) • Data Joins, Unions, and Filters • Sorting and Grouping Data	6
3.0		**Creating Basic Visualizations**	
		• Bar Charts, Line Graphs, Pie Charts • Maps and Geographic Data Visualizations • Tree Maps, Heat Maps, and Scatter Plots • Dual Axis and Combined Charts • Formatting and Annotating Visualizations	6
4.0		**Dashboards and Storytelling**	
		• Designing Interactive Dashboards • Using Filters, Parameters, and Actions • Storytelling with Data • Best Practices in Dashboard Design	6
5.0		**Case Studies and Project**	

5		• Real-world Case Studies in Education, Marketing, and Finance • Capstone Project: Create a Data Story using Tableau • Presentation and Peer Review of Dashboards	6

Text Books	
1	Murray, D. (2016). *Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software* (2nd ed.). Wiley.
2	Chabot, J. (2018). *Learning Tableau 2019: Tools for Business Intelligence, data prep, and visual analytics* (4th ed.). Packt Publishing.
References	
1	Wexler, S., Shaffer, J., & Cotgreave, A. (2017). *The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios*. Wiley.
2	Few, S. (2009). *Now You See It: Simple Visualization Techniques for Quantitative Analysis*. Analytics Press.
3	Krumm, J. (2020). *Tableau Desktop Specialist Certification Guide*. Apress.

- Internal Assessment (T1, T2 and FET):

1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
2. Fifth module will be assessed for 5 marks separately.

- Semester End Examination:

1. Question paper will comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be 2 hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16MM041	Foundation Skills of Machine Learning	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16MM041	Foundation Skills of Machine Learning	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:

This course provides a foundational understanding of machine learning (ML) concepts, methods, and applications. It equips students with essential skills to preprocess data, develop machine learning models, and evaluate their performance. Emphasis is placed on supervised and unsupervised learning, model optimization, and ethical considerations. By the end of the course, students will have a practical understanding of ML techniques to solve real-world problems.

Pre-requisites: Basic knowledge of programming and mathematics.

Course Objectives:

1.	To introduce the fundamentals of machine learning and its applications across domains
2.	To enable students to understand and apply data preprocessing and feature engineering techniques
3.	To develop skills for implementing supervised and unsupervised learning models
4.	To explore model evaluation, optimization techniques, and the ethical implications of AI/ML systems

Course Outcomes:

CO1	**Explain**[1] the principles and types of machine learning, and their applications in solving problems
CO2	**Build**[3] basic supervised and unsupervised machine learning models
CO3	**Apply**[3] feature engineering, model evaluation, and optimization techniques
CO4	**Develop**[3] a Comprehensive Understanding of AI and ML Technologies

Course Contents

Module	Unit	Description	Hours
1.0		**Fundamentals of Machine Learning**	
1	1.1	Introduction to Machine Learning (ML), Types of ML: Supervised, Unsupervised, and Reinforcement Learning	9
	1.2	Applications and trends in ML, ML workflows and tools (Python, Jupyter Notebook, Scikit-learn)	
2.0		**Data Preprocessing and Feature Engineering**	
2	2.1	Importance of data quality in ML, Techniques for handling missing data, outliers, and imbalanced datasets	9
	2.2	Feature scaling: Standardization and normalization, Feature selection methods: Recursive Feature Elimination (RFE), Lasso	
3.0		**Supervised Learning Models**	
3	3.1	Introduction to Supervised Learning, Regression: Linear Regression, Logistic Regression	9
	3.2	Decision Trees, Random Forests, Gradient Boosting (e.g., XGBoost)	
4.0		**Unsupervised Learning and Clustering**	
4	4.1	Introduction to Unsupervised Learning, Clustering techniques: K-Means, Hierarchical Clustering, DBSCAN	9
	4.2	Dimensionality reduction in unsupervised learning: PCA and t-SNE	
	4.3	Anomaly Detection, Applications of unsupervised learning	
5.0		**Introduction to Advanced Topics**	
5	5.1	Basics of Neural Networks and Deep Learning	9

	5.2	Ensemble Learning: Bagging, Boosting, Random Forests	
	5.3	Introduction to Reinforcement Learning, Ethics in AI and ML	

Text Books:

1. Murphy, K. P. (2012). Machine learning: A probabilistic perspective. MIT Press.
2 Ng, A. (2017). Machine learning yearning.

References:

1. Jain, V. K. (2020). *Machine Learning*. Khanna Publishing House
2. Vinod Chandra, S. S. (2014). *Artificial Intelligence & Machine Learning*. PHI.

Evaluation Scheme

- **Internal Assessment (T1, T2 and FET):**
  1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
  2. Fifth module will be assessed for 5 marks separately.
- **Semester End Examination:**
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 2 /3/ 4 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE501	Unstructured Database	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PE501	Unstructured Database	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:

Unstructured Database Systems is a comprehensive course designed to explore the principles, technologies, and tools associated with managing, storing, and analyzing unstructured data. In an era where data comes in various formats such as text, images, videos, and social media content, this course equips students with the skills to handle non-relational and schema-less databases effectively.
Pre-requisites: Understanding of traditional relational databases (e.g. SQL).

Course Objectives:

1.	To understand Data Fundamentals.
2.	To explore Database Architectures
3.	To apply Data Modeling Techniques.
4.	To design Real-World Applications.

Course Outcomes: after the end of this course students will able to

CO1	**Understand**[2]Describe the differences between structured, semi-structured, and unstructured data using concepts such as Venn diagrams to illustrate data relationships.
CO2	**Construct**[5] Develop data models and NoSQL schema designs to organize and store unstructured data effectively.
CO3	**Calculate**[4]Apply algorithms to process and analyze unstructured data, such as calculating similarity scores or performing clustering for large datasets.
CO4	**Analyze and interpret**[4] Evaluate and interpret data from unstructured sources, draw meaningful insights, and make data-driven decisions using statistical and big data tools.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Unstructured Data**	
1	1.1	Overview of Data Types: Structured, Semi-Structured, and Unstructured Data; Challenges and Opportunities Characteristics and examples of unstructured data (e.g., text, images, videos, social media data).	9
	1.2	Comparison of Relational vs. Non-Relational Databases; Introduction to NoSQL Databases (e.g., MongoDB, Cassandra).	
2.0		**Data Modeling for Unstructured Databases**	
2	2.1	Data Models and Schema Design: Key-Value, Document-Oriented, Column-Family, and Graph Databases Designing Data Structures for Unstructured Data (e.g., JSON, BSON).	9
	2.2	Indexing, Querying, and Storage Techniques for NoSQL Databases	
3.0		**Big Data Frameworks for Unstructured Data**	
3	3.1	Introduction to Big Data Ecosystem: Hadoop, Apache Spark, and HDFS.	9
	3.2	Distributed Data Storage and Processing for Large-Scale Unstructured Data.	
4.0		**Unstructured Data Analytic**	
4	4.1	Sentiment Analysis, Text Mining, and Natural Language Processing (NLP).	9
	4.2	Multimedia Data Analysis: Image and Video Processing Techniques.	
	4.3	Case Studies: Social Media Analytic s and Recommend-er Systems.	

5.0		**Advanced Topics and Applications**	
5	5.1	Scalability, Replication, and Consistency in NoSQL Databases.	9
	5.2	Security and Privacy Concerns in Unstructured Databases.	
	5.3	Emerging Trends in Unstructured Data Management (e.g., Graph Databases, AI Integration).	

Text Books:

1 Shashank Tiwari, *"Professional NoSQL"*, Wiley, 2011.

2 Tom White, *"Hadoop: The Definitive Guide"*, 4th Edition, O'Reilly Media, 2015.

3 Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, *"Introduction to Data Mining"*, Pearson, 2005.

References:

1 *Martin Kleppmann*, "Designing Data-Intensive Applications", *O'Reilly Media, 2017.* (Covers principles and design for Units 1-5)

2 *George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair,* "Distributed Systems: Concepts and Design", *5th Edition, Pearson, 2011.* (For scalability and distributed systems in Unit 5)

3 *Doug Cutting and Mike Cafarella,* "Hadoop: The Big Data Framework", *Community Reference Edition, 2016.* (For Unit 3)

- **Internal Assessment (T1, T2 and FET):**

1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
2. Fifth module will be assessed for 5 marks separately.

- **Semester End Examination:**

1. Question paper will comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be 2 /3/ 4 hours.
3. The students need to solve all 5 questions.

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Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE502	Advanced Java	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PE502	Advanced Java	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:

The objective of this course is to teach the learner how to use Object Oriented paradigm to develop code and understand the concepts of Core Java and to cover-up with the pre-requisites of Core java

Pre-requisites: Basic understanding of C programming concepts

Course Objectives:

1.	**Mastery of advanced Java concepts** including Java Servlets, JavaServer Pages (JSP), and Enterprise JavaBeans (EJB) for building scalable and robust web applications.
2.	**Proficiency in utilizing frameworks** such as Spring and Hibernate to facilitate rapid development and efficient management of Java-based projects.
3.	**Understanding of advanced topics** like concurrency, networking, and security in Java applications, ensuring the ability to develop high-performance, secure, and reliable software systems.
4.	**Acquisition of practical skills** through hands-on projects and real-world applications, enabling students to develop comprehensive Java solutions that meet industry standards and requirements.

Course Outcomes: after the end of this course students will able to

CO1	Explain fundamental and object oriented concepts of Java.
CO2	Design basic application in java using Graphical User Interface.
CO3	Develop web based applications using servlet and jsp.
CO4	Demonstrate fundamental concept of Multithreading and JDBC in Java.

Course Contents

Module	Unit	Description	Hours
1.0		**Fundamental Programming in Java**	
1	1.1	The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Arrays Jagged Array.	9
	1.2	OOPS: Introduction, Class, Object, Static Keywords, Constructors, this keyword, Inheritance, Inner class, Anonymous Inner class, super keyword, Polymorphism (overloading and overriding), Abstraction, Encapsulation, Abstract Classes, Interfaces	
2.0		**Java Servlets and JavaServer Pages (JSP):**	
2	2.1	Introduction to Servlets and JSP Servlet Lifecycle and Event Handling Session Management and Servlet Filters	9
	2.2	JSP Syntax and Scripting Elements Expression Language (EL) and JSP Standard Tag Library (JSTL) Model View Controller (MVC) architecture using Servlets and JSP	
3.0		**Enterprise JavaBeans (EJB):**	

3	3.1	Overview of EJB architecture Session Beans, Entity Beans, and Message-Driven Beans EJB Lifecycle and Dependency Injection (DI)	9
	3.2	Transaction Management and Security in EJB Introduction to EJB containers and deployment	
4.0		**Advanced Java Concepts:**	
4	4.1	Multithreading and Concurrency in Java Networking and Socket Programming Java Database Connectivity (JDBC) for database interaction	9
	4.2	Exception Handling and Logging Generics and Collections Framework	
5.0		**Wrapper Classes & Framework :**	
5	5.1	Introduction, Byte, Short, Integer, Long, Float, Double, Character, Boolean classes Collection	9
	5.2	Introduction, util Package interfaces, List, Set, Map, List interface & its classes, Set interface & its classes, Map interface & its classes	
	5.3	Inner Classes: Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class AWT: Introduction, Components, Event-Delegation-Model, Listeners, Layouts, Individual components Label, Button, CheckBox, Radio Button, Choice, List, Menu, Text Field, Text Are	

Text Books:

1 Horstmann, Cay S. 2016. "Core Java, Volume II--Advanced Features." 11th ed. Upper Saddle River, NJ: Prentice Hall.

2 Sierra, Kathy, and Bert Bates. 2020. "Head First Servlets and JSP: Passing the Sun Certified Web Component Developer Exam." 2nd ed. Sebastopol, CA: O'Reilly Media.

References:

1 Keith, Gary, Patrick Niemeyer, and Joshua Juneau. 2020. "Enterprise JavaBeans 3.1." 6th ed. Sebastopol, CA: O'Reilly Media.

2 Walls, Craig. 2016. "Spring in Action." 4th ed. Shelter Island, NY: Manning Publications.

- **Internal Assessment (T1, T2 and FET):**

1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
2. Fifth module will be assessed for 5 marks separately.

- **Semester End Examination:**

1. Question paper will comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be 2 /3/ 4 hours.
3. The students need to solve all 5 questions.

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Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE503	Introduction to Cloud computing	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PE503	Introduction to Cloud computing	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:

This course introduces students to the fundamental concepts of cloud computing, its architecture, services, storage, virtualization and applications. Emphasizing hands-on learning and practical knowledge, the course enables students to understand the basic of cloud computing and the uses of cloud applications in day to day life.

Pre-requisites: Knowledge of C++ or Java

Course Objectives:

1.	To learn the fundamental concepts of cloud computing..
2.	To Explore impact and contribution of cloud technologies to various domains.
3.	To understand the use of cloud based services and tools to develop and deploy applications
4.	To Encourage innovative thinking to design simple cloud-based solutions for real-world problems.

Course Outcomes: after the end of this course students will able to

CO1	**State**[1] service models and cloud deployment models of Cloud computing.
CO2	**Explain**[2] layered cloud architecture and virtualization.
CO3	**Determine**[4] types of cloud storage and data security issues.
CO4	**Develop**[6] applications and deploy them using Cloud service providers.(AWS,GCP)

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Cloud Computing**	
1	1.1	Introduction to Cloud Computing: Overview of cloud computing concepts, need of cloud computing, history of Cloud computing, Cloud service models: IaaS, PaaS, SaaS, DaaS, MaaS, CaaS, DBaaS.	9
	1.2	Cloud deployment models: Public, private, hybrid, community clouds, Pros and Cons of Cloud Computing, Benefits of Cloud Computing.	
2.0		**Cloud Computing Architecture and Storage**	
2	2.1	Cloud computing stack :Comparison with traditional computing architecture (client/server) ,Key components of cloud architecture: Frontend, Backend, and Middleware.	9
	2.2	Layered Cloud Architecture Design :NIST Cloud Computing Reference Architecture ,Advantages of Cloud Storage ,Cloud Storage Providers : S3.	
3.0		**Virtualization**	
3	3.1	Virtualization architecture and its needs, benefits and challenges, Types of virtualization,	9
	3.2	Virtualization structure, open source virtualization technology, Draw backs of virtualization.	
	3.3	Hypervisor, load balancing, Google cloud, VMware, Amazon EC2	

4.0		**Cloud computing Services ,Storage & Security**	
4	4.1	Cloud services: IaaS, SaaS, PaaS, cloud models- public, private, hybrid and community clouds. Open cloud implementation and administration (Eucalyptus), Types of cloud storage: block, file, and object storage, cloud backup.	9
	4.2	Data privacy and security issues, Access control and authentication. Reputation, Risk, Authentication in Cloud Computing.	
	4.3	Disaster recovery, data integration, data transformation, data migration,	
5.0		**Cloud Technologies and Applications**	
5	5.1	Cloud Applications: Moving Applications to the Cloud ,Microsoft Cloud Services , Google Cloud Applications ,Amazon Cloud Services	9
	5.2	Cloud platforms integrate healthcare-specific tools: telemedicine apps and health record systems (AWS for Healthcare).	
	5.3	Cloud-based learning management systems (LMS): Moodle and Google Classroom enhance e-learning	

Text Books:

1 Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", Pearson, 2013.

2 Rajkumar Buyya, "Cloud Computing: Principles and Paradigms", Wiley, 2011.

3 John W. Rittinghouse, "*Cloud Computing: Implementation, Management, and Security"*, CRC Press, 2012.

References:

1 Kailash Jauaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, "Cloud Computing", Black Book, Dreamtech , 2014

2 Barrie Sosinsky, "Cloud Computing Bible", Wiley India Pvt. Ltd. 2012.

3 Prasant Kumar Pattnaik et.al., "Fundamentals of Cloud Computing",Vikas Publication House Pvt. Ltd.,first Edition 2015

- **Internal Assessment (T1, T2 and FET):**

1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
2. Fifth module will be assessed for 5 marks separately.

- **Semester End Examination:**

1. Question paper will comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be 2 /3/ 4 hours.
3. The students need to solve all 5 questions.

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Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16VS504	UI/UX Design	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	04	-	-	02	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (POE)		
U16VS504	UI/UX Design	Term Work	Min pass %	Marks	Min pass %	Total (Marks)
		25	40	25	40	50

Course Description:

This course introduces students to the principles and practices of User Interface (UI) and User Experience (UX) design, focusing on creating intuitive, engaging, and user-centered digital products. Students will explore design thinking, user research, wireframing, prototyping, and interaction design, using industry-standard tools such as Figma, Adobe XD, and InVision.

Pre-requisites: Basic Computer Skills

Course Objectives:

1.	Understand the fundamental principles and importance of User Interface (UI) and User Experience (UX) design in digital product development.
2.	Apply design thinking methodologies to create user-centered and visually engaging digital interfaces.
3.	Conduct user research and usability testing to analyze user needs and improve design solutions.
4.	Explore emerging trends in UI/UX design and prepare a professional portfolio showcasing design projects.

Course Outcomes: After the end of this course students will be able to

CO1	Understand the foundational concepts of UI/UX design and its importance in digital product development.
CO2	Conduct user research and apply design principles to create user- centred solutions.
CO3	Develop wireframes, prototypes, and interactive UI designs using industry-standard tools.
CO4	Explore advanced UI/UX design techniques and trends, and effectively present a professional portfolio

List of Experiments

1. Create a comparison chart highlighting the key differences between UI and UX design. Use examples of popular applications to illustrate the differences.
2. Conduct a usability analysis of a competitor's app or website. Identify pain points and suggest improvements.
3. Develop a small project where you gather user feedback to iterate on asimple app or website design.
4. Participate in a design sprint. Document each stage (Empathize, Define, Ideate, Prototype, Test) and present findings.
5. Analyze two case studies of well-known apps. Create a presentation on what makes one successful and where the other fails.
6. Redesign a simple website or app screen focusing on visual hierarchy, consistency, alignment, and contrast.
7. Create three design mockups using different color schemes and typography. Evaluate user preferences through surveys.
8. Design and conduct a short survey or interview. Summarize findings and apply them to improve an interface.
9. Create user personas and map their journey for a small e-commerce site.
10. Use tools like Hotjar or Google Analytics to track user behavior on a website.Present insights.

11. Develop low-fidelity wireframes for a new app concept.
12. Create a high-fidelity prototype using Figma or Adobe XD.
13. Design a responsive landing page that adjusts to desktop, tablet, and mobile screens.
14. Conduct usability testing on your prototype. Record issues and iterate on the design.
15. Refine a design project based on peer or user feedback.
16. Design interactive UI elements (buttons, forms, menus) for a web app.
17. Implement micro-interactions for a web page
18. Evaluate an existing app for accessibility and redesign parts to improve inclusivity.
19. Create a mobile-first design and adapt it to desktop.
20. Perform a heuristic evaluation on a classmate's project.
21. Research and apply a modern design trend (dark mode, glassmorphism) to a project.
22. Develop an interactive prototype using In Vision or Axure.
23. Experiment with AI-based design tools and document how they assist in the design process.
24. Collaborate with a developer to design and implement a small project.
25. Develop a UI/UX portfolio showcasing all completed experiments and projects..

Text Book:

1. Krug, S. (2014*).* Don't make me think, revisited: A common sense approach to Web usability (3rd ed.). New Riders.

References:

1. Norman, D. A. (2013). *The design of everyday things* (Revised and expanded ed.). Basic Books.

Evaluation Scheme

1. Term work assessment shall be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
3. Based on above scheme grading and Term work assessment should be done.
4. OE/POE shall be based on all Term work and work carried out during semester.

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Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U16PC503	**Introduction to Artificial Intelligence Lab**	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U16PC503	**Introduction to Artificial Intelligence Lab**	25	40%	-	-	25

List of Experiments

Experiments based on course content of **Introduction to Artificial Intelligence**

Text Books:

1 Herbert Schildt, Java The Complete Reference, Ninth Edition, McGraw-Hill Education,
2 E. Balagurusamy, Programming with Java, Tata McGraw-Hill Education India, 2014

References:

1 Programming in JAVA, 2nd Ed, Sachin Malhotra & Saurabh Choudhary, Oxford Press
2 The Java Tutorials: http://docs.oracle.com/javase/tutorial/

Evaluation Scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.

2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.

3. Based on above scheme grading and FEP assessment should be done.

Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U16PC504	Data Structures Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U16PC504	Data Structures Lab	25	40%	-	-	25

List of Experiments

Experiments based on course content of **Data Structures (U16PC502)**

Text Books:

1 "Data Structures and Algorithms in C++" by Adam Drozdek

2 Data Structures and Algorithms Made Easy" by Narasimha Karumanchi

3 Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein

References:

1 "Data Structures using C" by Reema Thareja

2 "Algorithms, Part I and Part II" by Robert Sedgewick and Kevin Wayne

3 "Data Structures and Algorithm Analysis in C" by Mark Allen Weiss.

Evaluation Scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
3. Based on above scheme grading and FEP assessment should be done.

Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U16MM042	Foundation Skills of Machine Learning Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U16MM042	Foundation Skills of Machine Learning Lab	25	40%	-	-	25

List of Experiments

Experiments based on course content of Foundation Skills of Machine Learning (U16MM041)

Text Books:

1. Murphy, K. P. (2012). Machine learning: A probabilistic perspective. MIT Press.
2 Ng, A. (2017). Machine learning yearning.

References:

1. Jain, V. K. (2020). *Machine Learning*. Khanna Publishing House
2. Vinod Chandra, S. S. (2014). *Artificial Intelligence & Machine Learning*. PHI.

Evaluation Scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.

2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.

3. Based on above scheme grading and FEP assessment should be done.

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Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U16PE504	Unstructured Database Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U16PE504	Unstructured Database Lab	25	40%	-	-	25

Experiments based on course content of Unstructured Database(U16PE501)

Text Books:

1 Shashank Tiwari, "Professional NoSQL", Wiley, 2011. (For Units 1 & 2)

2 Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media, 2015. (For Unit 3)

3 Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, "Introduction to Data Mining", Pearson, 2005. (For Unit 4)

References:

1 Martin Kleppmann, "Designing Data-Intensive Applications", O'Reilly Media, 2017. (Covers principles and design for Units 1-5)

2 George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, "Distributed Systems: Concepts and Design", 5th Edition, Pearson, 2011. (For scalability and distributed systems in Unit 5)

Evaluation Scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
3. Based on above scheme grading and FEP assessment should be done.

Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U16PE505	Advanced Java Lab	-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
		Term work	Min pass	Marks	Min pass	Total (Marks)
U16PE505	Advanced Java Lab	25	40%	-	-	25

List of Experiments

Experiments based on course content of **Advanced Java**

Text Books:

1 Keith, Gary, Patrick Niemeyer, and Joshua Juneau. 2020. "Enterprise JavaBeans 3.1." 6th ed. Sebastopol, CA: O'Reilly Media.

2 Walls, Craig. 2016. "Spring in Action." 4th ed. Shelter Island, NY: Manning Publications.

References:

1 Walls, Craig. 2016. "Spring in Action." 4th ed. Shelter Island, NY: Manning Publications.

2 Keith, Gary, Patrick Niemeyer, and Joshua Juneau. 2020. "Enterprise JavaBeans 3.1." 6th ed. Sebastopol, CA: O'Reilly Media.

Evaluation Scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
3. Based on above scheme grading and FEP assessment should be done.

Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE506	Introduction to Cloud Computing Lab	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
U16PE506	Introduction to Cloud Computing Lab	Term work	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

List of Experiments

Experiments based on course content of **Introduction to Cloud Computing**

Text Books:

1 Arshdeep Bahga, “Cloud Computing: A Hands-On Approach”, VPT, 2014
2 Rajkumar Buyya, “Cloud Computing: Principles and Paradigms”, Wiley, 2011
3 P. K. Suri, “Cloud Computing Lab Manual”, Khanna Publishing, 2017

References:

1 Kailash Jauaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, “Cloud Computing”, Black Book, Dreamtech , 2014
2 Barrie Sosinsky, “Cloud Computing Bible”,Wiley India Pvt. Ltd. 2012.
3 Prasant Kumar Pattnaik et.al.,”Fundamentals of Cloud Computing”, Vikas Publication House Pvt. Ltd.,first Edition 2015

Evaluation Scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
3. Based on above scheme grading and FEP assessment should be done.

SEMESTER VI

Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
		Theory	Practical	Tutorial	Theory	Practical	Tutorial
U16PC601	Advanced Application Development	03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
		T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
U16PC601	Advanced Application Development	10	10	5	25	40%	50	40%	75

Course Description:
This course is aimed with knowledge and practice of designing and developing large complex web applications, e.g. large enterprise software systems in web-based environment. Students will learn advanced software frameworks for web development and apply them in practice.

Pre-requisites: Web Technology

Course Objectives:

1.	To learn to create server- side web applications using Node.js and MongoDB database.
2.	To develop web and mobile applications using Express Framework.
3.	To understand structural framework and develop dynamic web apps using AngularJS
4.	To develop simple mobile applications in Flutter using Dart language.

Course Outcomes: after the end of this course students will able to

CO1	**Apply**[3] node.js for building fast, scalable network application.
CO2	Implement the applications using in NoSQL, document-oriented MongoDB database.
CO3	**Identify**[2] basic methods, tools and techniques for developing web applications using AngularJS framework.
CO4	**Develop**[5] robust mobile applications using Flutter and Dart Programming.

Course Contents

Module	Unit	Description	Hours
1.0		**Learning Node.js**	
1	1.1	Introduction to Node.js, Installing Node.js. Working with Node.js packages: using .json package, Creating a Sample Node.js Application. Understanding the Node.js Event Model, Blocking I/O in Node.js	9
	1.2	Implementing Timers, Accessing the File System from Node.js, Creating an HTTP Webserver with Node.js. Responding to HTTP Requests. Routing in Node.js.	
2.0		**Learning MongoDB**	
2	2.1	Introduction to MongoDB, Installing MongoDB, MongoDB Compass, MongoDB Shell Interface, Connecting to MongoDB. Creating Schemas and Models.	9
	2.2	MongoDB datatypes, CRUD operation in MongoDB: Inserting Documents, Updating Documents, Querying Documents using find(), Deleting Documents.	
3.0		**Understanding AngularJS**	
3	3.1	Introduction to AngularJS, Learning AngularJS Modules, Expression, Directives, Model, Data Binding, Scopes, Controllers, Services, Filters, Generating Content with the CLI, Creating an AngularJS Application.	9
	3.2	Understanding and implementing NgModule, Angular Router, Configuring Templates. Working with Template-driven Forms, Working with Reactive Forms, Validating Form Data, Error handling in AngularJS	
4.0		**Understanding Flutter**	

4	4.1	Flutter basics, Flutter Framework, Android Studio, Flutter SDK, Installing and Configuring Flutter SDK. Dart Programming: main() function, Dart Variables, Dart Data Types, Dart Conditional Operators, Control Flow & Loops, Dart Functions - Functions, Function Structure, creating a Function, Function Returning Expression	9
	4.2	Object-Oriented Programming (OOP): Creating a Class, Adding Methods to Classes, Class: Getters and Setters, Class Inheritance, Abstract Class.	
5.0		**Flutter Widgets Fundamentals**	
5	5.1	Scaffold Widget, Image Widget, Container Widget, Column and Row Widgets, Icon Widget, List Widgets, Form Widgets, Checkbox Widgets, Radio Button Widgets etc., Layouts in Flutter, State Management Widget, Flutter Gestures	9
	5.2	Widgets Navigation and Routing: Button Widget, App Structure and Navigation, Navigate to a New Screen and Back, Navigate with Named Routes, Send and Return Data among Screens, Flutter Animation.	

Text Books:

1 Sandeep Panda, "AngularJS: Novice to Ninja: Elegant, Powerful, Testable, Extendable", SitePoint; First edition, 2014

2 Brad Green and ShyamSeshadri, "AngularJS – Up and Running", O′Reilly; 1 edition,2014

References:

1 "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications" by Brad Dayley, Brendan Dayley, Caleb Dayley, Second Edition Pearson Publications, 2018"

2 Beginning Flutter: A Hands On Guide to App Development" by Marco L. Napoli, First Edition, Wrox Wiley Brand Publications, 2019

Full Stack Javascript Development with Mean - MongoDB, Express, AngularJS, and Node.JS" by Adam Bretz, Colin J Ihrig, Shroff/SitePointPublications , 2015

Evaluation Scheme:

- **Internal Assessment (T1, T2 and FET):**

1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
2. Fifth module will be assessed for 5 marks separately.

- **Semester End Examination:**

1. Question paper will comprise of 5 questions, each carrying 10 marks.
2. The duration of end semester examination shall be 2 /3/ 4 hours.
3. The students need to solve all 5 questions.
4. Question No.1 will be compulsory and based on entire syllabus.
5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PC602	C# programming	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PC602	C# programming	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:
This course gives a foundation in the C# Programming, including the Framework, Object Oriented console applications, and analysis by teaching the concepts of C# Programming and a look at real-world solutions.

Prerequisite: Nil

Course Objectives:

1.	To Understand the fundamental syntax and structure of the C# programming language.
2.	To Gain a basic understanding of data types, variables, and operators in C#.
3.	To Design Win Form Application.
4.	To implement and Apply in real-world C# projects

Course Outcomes: after the end of this course students will able to

CO1	**Explain**[2] Write, debug, and optimize C# programs.
CO2	**Describe**[2] Work with databases and integrate external resources into C# applications.
CO3	**Develop**[3] Design and develop object-oriented applications concepts using C#.
CO4	**Apply**[3] Implement real-world C# projects with ADO.NET Architecture and Database Connectivity.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to .NET Framework Architecture**	
1	1.1	Introduction to .NET Framework Overview of .NET, Features of .NET, Managed and unmanaged code, Meta Data , .NET types and .NET object and name spaces Architecture of DOT NET Framework: CLR, CTS, MSIL, JIT, CLS, FCL , Types of JIT , Visual studio .NET IDE NET Framework Base Classes, DLL and Exe.	9
	1.2	Data Types, Value and Reference Types, Boxing and Unboxing Properties : Set and Get C# - Flow Control: Branching, Switching and Looping	
2.0		**Working with Classes and Objects**	
2	2.1	Object oriented Concepts C# Program compilation and execution Command Line Arguments, Programming Examples using Console application, Classes and Objects, Inheritance.	9
	2.2	Polymorphism, Abstract Classes, Sealed Classes, Partial Classes.	
3.0		**WinForm Application**	
3	3.1	Introduction to Windows Form Application Using C# IDE – (Integrated Development Environment), Form Controls: Label, Button, Textbox, Checkbox, RadioButton, Timer, calendar, ListBox, Image and overview of remaining all common controls its properties and events	9

	3.2	Event Handling in WinForms Button Click Event, TextBox TextChanged Event, Form properties and methods, Dialog boxes: MessageBox, OpenFileDialog, SaveFileDialog	
4.0		**Exception Handling**	
4	4.1	Try, Catch, and Finally Blocks Basic syntax of try, catch, and finally. Catching multiple exceptions. Understanding finally block execution Exception Class, User defined exception.	9
	4.2	Throwing Exceptions-throw keyword, Creating custom exceptions using throw.Example: Handling a Division by Zero Exception Using try-catch to prevent application crashes.	
5.0		**Database and ADO.NET**	
5	5.1	Introduction to ADO.NET Connecting to a database (SQL Server, SQLite, etc.) Executing queries and commands Retrieving data (DataReader, DataSet, DataAdapter)	9
	5.2	Performing CRUD operations (Create, Read, Update, Delete) from a Windows application Connected and Disconnected architecture, Data binding using ADO.net , Report generation, simple and parameterized reports	

Text Books:

1 C# 10.0 and .NET 6: Modern Cross-Platform Development by Mark J. Price

2 C# Programming Yellow Book by Rob Miles

References:

1 C# 2008 Programming covers. NET 3.5 (Black Book).

2 ASP .NET-The Complete Reference Tata MacGraw Hill.

3 Bill Evjen, Professional ASP.NET 3.5 in C# and VB.

4 Pro C# 8 with .NET Core 3" by Andrew Troelsen.

Evaluation Scheme

- **Internal Assessment (T1, T2 and FET):**
  1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
  2. Fifth module will be assessed for 5 marks separately.
- **Semester End Examination:**
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 2 /3/ 4 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

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Theory Course

Course code	Course Name	Teaching Scheme (Hr/week)			Credits Assigned		
U16OE061	Multimedia Computing	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		02	-	-	02	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam(SEE)		
U16OE061	Multimedia Computing	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		-	10	5	15	40%	35	40%	50

Course Description:
This course provides an overview of the fundamental concepts, technologies, and tools involved in multimedia computing. Students will explore how various forms of media—such as text, images, audio, video, and animation—are captured, represented, processed, and delivered using computing systems. The course covers core principles of multimedia systems including data compression; multimedia file formats, streaming protocols, human-computer interaction, and multimedia applications in fields such as gaming, education, virtual/augmented reality, and digital entertainment.

Pre-requisites: Basic programming knowledge and familiarity with data structures and algorithms.

Course Objectives:

1.	Understand the basic concepts and components of multimedia systems including text, images, audio, video, and animation.
2.	Recognize and use standard multimedia file formats and codecs for storing and sharing digital content.
3.	Apply data compression techniques (e.g., JPEG, MP3, MPEG) to optimize multimedia performance and storage.
4.	Use multimedia authoring tools to create interactive presentations, animations, and user interfaces.
5.	Integrate multimedia elements into software applications and websites for enhanced user experience.
6.	Understand the fundamentals of image processing, sound editing, and video streaming from a computing perspective.

7.	Explore practical applications of multimedia computing in areas such as e-learning, entertainment, advertising, and mobile apps.

Course Outcomes: after the end of this course students will able to

CO1	**Explain**[2] the key concepts and components of multimedia systems, including types of media and their digital representations.
CO2	**Demonstrate**[4] knowledge of multimedia file formats, standards, and compression techniques used in real-world applications.
CO3	**Apply3** techniques for image processing, audio manipulation, and video editing in software development.
CO4	**Create**[6] interactive multimedia presentations and interfaces using authoring tools and design principles.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Multimedia System**	
1	1.1	Definition, types, characteristics of multimedia, Multimedia components: Text, Image, Audio, Video, Animation	6
	1.2	Applications of multimedia, Multimedia systems and architecture, Multimedia Vs Hypermedia	
2.0		**Working with Text and Images**	
2	2.1	Text in multimedia, fonts and typography, Image types: bitmap vs vector, File formats: JPG, PNG, BMP, GIF, SVG	6
	2.2	Color models: RGB, CMYK, HSV, Image compression: Run Length Encoding, JPEG, PNG	
3.0		**Audio and Video**	
3	3.1	Digital audio: Sampling, quantization, File formats: MP3, WAV, AAC, Audio compression and editing basics.	6
	3.2	Video basics: frame rate, resolution, aspect ratio, Video formats: MP4, AVI, MOV, Video compression: MPEG, H.264, Basics of video streaming	
4.0		**Animation and Authoring**	

4	4.1	Types of animation: 2D, 3D, Principles of animation, Creating simple animations tools like Flash, Blender	6
	4.2	Multimedia authoring tools: Adobe Animate, Canva, Unity, Interactivity and scripting in multimedia	
5.0		**Multimedia on the Web & Emerging Trends**	
5	5.1	HTML5 multimedia (audio/video tags), JavaScript & CSS for multimedia effects, Multimedia in web UX/UI	6
	5.2	Mobile multimedia applications, AR, VR, and AI in multimedia, Digital media ethics and copyright	

TextBooks:

1. Vaughan, T. (2014). *Multimedia: Making it work* (9th ed.). McGraw-Hill Education.
2. Steinmetz, R., & Nahrstedt, K. (2004). *Multimedia fundamentals: Vol. 1. Media coding and content processing*. Pearson Education.

Evaluation Scheme

- **Internal Assessment (T2 and FET):**

  1. T2 should be based on first three modules for 10 marks each.
  2. Fouth and fifth module will be assessed for 5 marks separately.

- **SemesterEnd Examination:**

  1. Question paper will comprise of 4 questions.
  2. The duration of end semester examination shall be 2 hours.
  3. The students need to solve all 4 questions.
  4. Question No.1 will be compulsory, based on entire syllabus and carries 5 marks.
  5. Remaining question (Q.2 to Q.4) will be selected from all the modules carries 5 marks each.

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16MM051	Predictive Modeling and analytics	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (ESE)		
U16MM051	Predictive Modeling and analytics	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:

This course is for TYBCA-VI Semester, it provides an in-depth exploration of predictive modelling and analytics, equipping students with the skills necessary to analyze data and make informed predictions. Throughout the course, students will learn to harness the power of data through various statistical and machine learning techniques to forecast future trends and behaviors

Pre-requisites: Elementary Mathematics and Statistics and Familiarity with programming languages commonly used in data science, such as Python or R.

Course Objectives:

1.	To understand the fundamental concepts of predictive modeling.
2.	To learn the process of data pre-processing and data analysis.
3.	To explore and apply various statistical methods.
4.	To implement predictive models using real-world data and tools.

Course Outcomes: after the end of this course students will able to

CO1	Understand[2] the fundamental concepts of predictive modeling.
CO2	Apply[3] statistical and machine learning techniques for predictive modeling.
CO3	Evaluate[5] the performance of predictive models.
CO4	Develop[3] predictive modeling techniques to solve real-world problems.

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Predictive Analytics**	
1	1.1	Overview of Predictive Analytics: Definition, importance, and applications. Predictive Modeling Process: Data collection, preprocessing, exploration, model selection, and evaluation. Types of Predictive Models: Classification, regression, and time series forecasting.	9
	1.2	Overview of Data Science Tools: Python libraries such as NumPy, Pandas, Matplotlib, Seaborn, and Scikit-learn.	
2.0		**Data Pre-processing**	
2	2.1	Data Cleaning: Handling missing values, duplicates, and outliers. Data Transformation: Normalization, scaling, encoding categorical variables. Exploratory Data Analysis (EDA): Visualization techniques (scatter plots, histograms, box plots) to understand data patterns.	9
	2.2	Data Integration: Combining data from different sources for a cohesive dataset. Handling Imbalanced Data: Techniques like oversampling, under sampling and SMOTE (Synthetic Minority Over-sampling Technique).	
3.0		**Regression and Classification Models**	
3	3.1	Linear Regression: mathematical formulation and implementation. Multiple Linear Regression: model fitting and diagnostics. Polynomial Regression: When and how to use polynomial regression. Evaluating Regression Models: Metrics such as Mean Squared Error (MSE), R-squared, and Adjusted R-squared.	9
	3.2	Logistic Regression: Binary and multi-class classification, decision boundaries. Decision Trees: Concept, algorithms (CART), and over fitting problem. Random Forests: Ensemble learning, bagging, and feature importance.	

	3.3	Support Vector Machines (SVM): Concept, kernels, and applications. K-Nearest Neighbors (KNN): Algorithm, distance metrics, and use cases. Model Evaluation: Accuracy, precision, recall, F1 score, ROC Curve, and AUC.	
4.0		**Advanced Techniques in Predictive Modeling**	
4	4.1	Ensemble Methods: Boosting (AdaBoost, Gradient Boosting, XGBoost), Bagging (Random Forest), and Stacking.	9
	4.2	Neural Networks: Introduction to deep learning, perceptron model, and back-propagation.	
5.0		***Model Evaluation and Validation***	
5	5.1	*Cross-Validation: K-fold cross-validation, Leave-one-out cross-validation (LOOCV).*	9
	5.2	*Hyper parameter Tuning: Grid Search and Random Search.* *Model Performance Metrics: Precision-Recall, ROC curve, and AUC.*	
	5.3	*Bias-Variance Tradeoff: Understanding the tradeoff between bias and variance in model performance.* *Confusion Matrix: Analyzing confusion matrices to understand model errors.*	

Text Books:

1 Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron.

2 Pattern Recognition and Machine Learning by Christopher Bishop.

3 Data Science for Business by Foster Provost and Tom Fawcett

4 The Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani, and Jerome Friedman.

5 Applied Predictive Modeling by Max Kuhn and Kjell Johnson

References:

1 The Elements of Statistical Learning: Data Mining, Inference, and Prediction by Trevor Hastie, Rob Tibshirani, and Jerome Friedman
2 Practical Machine Learning with Python by Dipanjan Sarkar, Raghav Bali, and Tushar Sharma
3 Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, and Jian Pei
4 Python Machine Learning by Sebastian Raschka

Evaluation Scheme

- **Internal Assessment (T1, T2 and FET):**
  1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
  2. Fifth module will be assessed for 5 marks separately.
- **Semester End Examination**:
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 2 /3/ 4 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE601	Cyber Security	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PE601	Cyber Security	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:

This course is designed so that a candidate can identify, analyze and remediate computer security breaches by learning and implementing the real-world scenarios in Cyber Investigations, Network Security.

Prerequisite: Computer Networks

Course Objectives:

1	To be able to thoroughly understand and categorize various protocols and it's vulnerabilities
2	To have an exact understanding of the real-time/hands on problems in the computer system and operating system and how to deal with them
3	To have an exact understanding of the various vulnerabilities found in web application
4	To understand various frameworks for security and hands-on tools related to forensics and security

Course Outcomes: after the end of this course students will able to

CO1	**Identify**[2] the design issues of network and algorithm techniques
CO2	**Explain**[2] the fundamental concepts of computer networks
CO3	**Summarize**[4] the different functionalities of layers.
CO4	**Apply** [3] various error detection/correction mechanism and the role/ use of addressing

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction:**	
1	1.1	Introduction: ISO/OSI and TCP/IP Protocol Stacks , Information Security Overview , Types of Attacks , E-commerce Security, Security threats, OWASP top Ten.	9
	1.2	Cyber Crime Overview: Introduction and Overview of Cyber Crime - Nature and Scope of Cyber Crime - Types of Cyber Crime: Social Engineering - Categories of Cyber Crime - Property Cyber Crime.	
2.0		**Challenges in Cyber Security**	
2	2.1	Cyber Crime Issues: Unauthorized Access to Computers - Computer Intrusions - White collar Crimes - Viruses and Malicious Code -	9
	2.2	Internet Hacking and Cracking - Virus Attacks – Software Piracy - Intellectual Property - Mail Bombs - Exploitation - Stalking and Obscenity in Internet	
3.0		**Cyber Crime and E-Mail Investigations**	
3	3.1	Introduction to Cyber Crime investigations, Investigations Tools,	9
	3.2	E-Mail Investigation – Tracking -IP Tracking - E-Mail, Recovery - Hands on Case Studies – Encryption and Decryption Methods Recovering Deleted Evidences - Password Cracking	
4.0		**Digital Forensics:**	
4	4.1	Introduction to Digital Forensics – Forensic Software and Hardware - Analysis and Advanced Tools -	9
	4.2	Forensic Technology and Practices - Forensic Ballistics and Photography - Face, Iris and Fingerprint Recognition Audio Video Analysis - Windows System Forensics - Linux System Forensics	

5.0		**Cyber Laws & Acts**	
5	5.1	Laws and Ethics - Digital Evidence Controls -	9
	5.2	Evidence Handling Procedures	
	5.3	Basics of Indian Evidence ACT IPC and CrPC - Electronic Communication Privacy ACT - Legal Policies.	

Text Books:

1 Cyber Security and IT Infrastructure Protection Author: John R. Vacca

2 The Cyber Security Handbook Authors: J.D. Biersdorfer and J. Heaton

3 Cyber security for Beginners Author: Raef Meeuwisse

References:

1 Robert M Slade, "Software Forensics", Tata McGraw Hill, New Delhi, 2005.

2 Bernadette H Schell, Clemens Martin, "Cybercrime", ABC CLIO Inc., California, 2000

3 Stallings, William, and Lawrie Brown. Computer Security: Principles and Practice. Pearson Education.

Evaluation Scheme

- **Internal Assessment (T1, T2 and FET):**
  1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
  2. Fifth module will be assessed for 5 marks separately.
- **Semester End Examination:**
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 2 /3/ 4 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE602	Data Mining and Warehousing	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PE602	Data Mining and Warehousing	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	40%	50	40%	75

Course Description:

This course will introduce the concepts of data warehouse and data mining, which gives a complete description about the principles, used, architectures, applications, design and implementation of data mining and data ware housing concepts.

Prerequisites: DBMS, Statistical and Mathematical Measures, Basic Programming Skills

Course Objectives:

1.	To introduce the architecture and design of data warehouses
2.	To impart knowledge on OLAP and data preprocessing techniques
3.	To learn basics concepts of data mining
4.	To learn about data mining algorithms to solve given problem

Course Outcomes: after the end of this course students will able to

CO1	**Illustrate**[2] the concepts of Data warehousing
CO2	**Design**[6] a data warehouse using proper schemas and perform OLAP operations using different OLAP models
CO3	**Apply**[3] normalization, encoding, and discretization techniques for data transformation
CO4	**Apply**[3] data mining algorithms to solve given problem

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction to Data Warehousing**	
1	1.1	Definition and benefits of data warehousing, Differences between OLTP and OLAP systems, Data warehouse architecture	9
	1.2	Data marts and metadata, Multidimensional data model: Star, Snowflake, and Fact Constellation schemas	
2.0		**Data Warehouse Design and Implementation**	
2	2.1	Top-down and Bottom-up design approaches, Fact and dimension tables, Measures: additive, semi-additive, non-additive	9
	2.2	OLAP operations: Roll-up, Drill-down, Slice, Dice, Pivot Types of OLAP: MOLAP, ROLAP, HOLAP OLAP server architecture	
3.0		**Data Preprocessing**	
3	3.1	Introduction, Data Cleaning - Missing Data Handling, Noise Removal, Data Integration, Data Reduction	9
	3.2	Data Transformation Techniques Normalization/Standardization - Min-Max Normalization, Z-score Normalization, Encoding Categorical Variables - One-Hot Encoding, Label Encoding Discretization - Converting continuous data to categorical	
4.0		**Introduction to Data Mining**	
4	4.1	Definition and scope of data mining, Knowledge Discovery in Databases (KDD) process	9
	4.2	Difference between data mining and machine learning, Applications and challenges in data mining	

5.0		**Core Data Mining Techniques**	
5	5.1	Association Rule Mining, Apriori and FP - Growth algorithms, Metrics: support, confidence, lift	9
	5.2	**Classification** - Decision Trees, Naive Bayes, k-Nearest Neighbors Model evaluation - Confusion matrix, precision, recall, F1-score	
	5.3	**Clustering** k-Means and Hierarchical clustering DBSCAN, Cluster evaluation methods	

Text Books:

1 Jiawei Han, Micheline Kamber, "Data Mining: ConceptsandTechniques",3rd Edition, Morgan Kaufmann Series, 2011 (For units 1, 2)

2 Dunham, Margaret H," Data Mining - Introductory and Advanced Topics: Prentice Hall", 2002. (For units 3, 4, 5)

References:

1 Daniel T. Larose, John Wiley, "Discovering Knowledge in Data: An Introduction to Data Mining", 2nd Edition, 2014

Evaluation Scheme

- **Internal Assessment (T1, T2 and FET):**
  1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
  2. Fifth module will be assessed for 5 marks separately.
- **Semester End Examination:**
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 2 /3/ 4 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

Theory Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE603	Internet of Things	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		03	-	-	03	-	-

Evaluation Scheme

Course Code	Course Name	Evaluation Scheme (In Semester)					Semester End Exam (SEE)		
U16PE603	Internet of Things	T1	T2	FET	Total	Min pass	Marks	Min pass	Total (Marks)
		10	10	5	25	0%	50	40%	75

Course Description:
This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions.

Prerequisite: Digital Electronics

Course Objectives:

1	understand **IoT Fundamentals.**
2	understand IoT's Machine to Machine (M2M) system.
3	design IoT platform applications.
4	apply IoT protocols sensibly when creating applications.

Course Outcomes: after the end of this course students will able to

CO1	**Explain**[2] the basics of IoT and its application sectors .
CO2	**Describe**[2] Machine to Machine(M2M) in IoT.
CO3	**Develop**[3] Applications IoT platforms .
CO4	**Apply**[3] IoT protocols appropriately for developing application .

Course Contents

Module	Unit	Description	Hours
1.0		**Introduction and concepts of IoT**	
1	1.1	Introduction to IOT, definition and characteristics of IoT , History and Evolution of IoT. IoT Devices: Devices, sensors, actuators, connectivity, and data processing, IoT Issues and Challenges.	9
	1.2	Architecture of Internet of Things. IoT Layers: Perception layer, network layer, edge layer, processing layer, and application layer.	
2.0		**IoT and M2M**	
2	2.1	M2M, difference between IOT and M2M, ETSI M2M Architecture	9
	2.2	Security in ETSI M2M framework, SDN and NFV for IOT, IOT system management, SNMP, Network operator requirements.	
3.0		**IoT Platforms and Hardware**	
3	3.1	Hardware Platforms and Energy Consumption, Operating Systems, IoT Hardware Components: Microcontrollers, Microprocessors, SoC, Sensors.	9
	3.2	Introduction to Arduino, Pi, Spark, Intel Galileo.	
4.0		**IoT protocols**	
4	4.1	RF Protocols: RFID, NFC; IEEE 802.15.4: ZigBee, Bluetooth Low Energy (BLE), IPv4, IPv6, 6LoWPAN.	9
	4.2	HTTP, CoAP, XMPP, AMQP, MQTT	

5.0		Case Studies	
5	5.1	Smart Cities, Agriculture, Health and Lifestyle, Industry, Home Automation, Telecom/5G, Smart Parking Architecture and Smart Traffic Control.	9

Text Books:

1 Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI

2 William Stallings, "Data and Computer Communications", Eighth Edition, PearsonEducation, 2011.

References:

1 Peterson, L. L., & Davie, B. S. (2011). Computer Networks: A Systems Approach (5th ed.). Morgan Kaufmann Publishers Inc.

2 Mir, N. F. (2007). Computer and communication networks. (1st ed.). PearsonEducation.

3 Author, A. A. (Year). Title of the article. Journal Name, Volume(Issue), Page numbers.

4 Forouzan, B. A. (2018). Data Communications and Networking (5th ed.). TMH.

5 Tanenbaum, A. S., & Wetherall, D. J. (2018). Computer Networks (5th ed.). Pearson Education.

Evaluation Scheme

- **Internal Assessment (T1, T2 and FET):**
  1. T1 should be based on first two modules and T2 should be based on next two modules, for 10 marks each.
  2. Fifth module will be assessed for 5 marks separately.
- **Semester End Examination:**
  1. Question paper will comprise of 5 questions, each carrying 10 marks.
  2. The duration of end semester examination shall be 2 /3/ 4 hours.
  3. The students need to solve all 5 questions.
  4. Question No.1 will be compulsory and based on entire syllabus.
  5. Remaining question (Q.2 to Q.5) will be selected from all the modules.

Lab Course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PC603	Advanced Application Development Lab	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
U16PC603	Advanced Application Development Lab	Term work	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

List of Experiments

Experiments based on Course (U16PC401) **Advanced Application Development**

References

1 Gary, Patrick Niemeyer, and Joshua Juneau. 2020. "Enterprise JavaBeans 3.1." 6th ed. Sebastopol, CA: O'Reilly Media.

2 Craig. 2016. "Spring in Action." 4th ed. Shelter Island, NY: Manning Publications.

Evaluation Scheme

1. FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
2. The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
3. Based on above scheme grading and FEP assessment should be done.

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Lab course

Course Code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PC604	**C# Programming Lab**	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
U16PC604	**C# Programming Lab**	Term work	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

List of Experiments

Experiments based on Course C# Programming (U16PC602)

Text Book:

C# Programming Yellow Book by Rob Miles

ro C# 9 with .NET 5 by Andrew Troelsen and Philip Japikse

Head First C# by Andrew Stellman and Jennifer Greene

References:

he C# Programming Language by Anders Hejlsberg, Scott Wiltamuth, and Peter Golde

C# 10 and .NET 6 – Modern Cross-Platform Development by Mark J. Price

Microsoft C# Programming Guide (Online Microsoft Documentation)

Evaluation Scheme

- FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.

- The grades will be converted to marks as per 'credit and grading system' manual and should be added and averaged.
- Based on the above scheme, grading and FEP assessment should be done.

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Lab course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16MM052	Predictive Modeling and Analytics Lab	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
U16MM052	Predictive Modeling and Analytics Lab	FEP	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

List of Experiments

Experiments based on Course **Predictive Modeling and Analytics**

Text Book:

Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron.

Pattern Recognition and Machine Learning by Christopher Bishop.

References:

The Elements of Statistical Learning: Data Mining, Inference, and Prediction by Trevor Hastie, Robert

Tibshirani, and Jerome Friedman

Practical Machine Learning with Python by Dipanjan Sarkar, Raghav Bali, and Tushar Sharma

Evaluation Scheme

- FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
- The grades will be converted to marks as per 'credit and grading system' manual and should be added and averaged.
- Based on the above scheme, grading and FEP assessment should be done.

Lab course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE604	**Cyber Security Lab**	**Theory**	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
U16PE604	Cyber Security Lab	Term work	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

List of Experiments

Experiments based on Course **Cyber Security (**U16PE601)

Text Book:

Cyber Security and IT Infrastructure Protection Author: John R. Vacca

The Cyber Security Handbook Authors: J.D. Biersdorfer and J. Heaton

Cyber security for Beginners Author: Raef Meeuwisse

References:

Robert M Slade, "Software Forensics", Tata McGraw Hill, New Delhi, 2005.

Bernadette H Schell, Clemens Martin, "Cybercrime", ABC CLIO Inc., California, 2000

tallings, William, and Lawrie Brown. Computer Security: Principles and Practice. Pearson Education.

Evaluation Scheme

- FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.

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Lab course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE605	Data Mining and Warehousing Lab	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
U16PE605	Data Mining and Warehousing Lab	Termwork	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

List of Experiments

Experiments based on Course **Data Mining and Warehousing (**U16PE605)

Text Book:

1 Jiawei Han, Micheline Kamber, "Data Mining: ConceptsandTechniques",3rd Edition, Morgan Kaufmann Series, 2011 (For units 1, 2)

2 Dunham, Margaret H," Data Mining - Introductory and Advanced Topics: Prentice Hall", 2002. (For units 3, 4, 5)

References:

1 Daniel T. Larose, Joh n Wiley, "Discovering Knowledge in Data: An Introduction to Data Mining", 2nd Edition, 2014

Evaluation Scheme

- FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.
- The grades will be converted to marks as per 'credit and grading system' manual and should be added and averaged.
- Based on the above scheme, grading and FEP assessment should be done.

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Lab course

Course code	Course name	Teaching Scheme (Hr/week)			Credits Assigned		
U16PE606	Internet of Things Lab	Theory	Practical	Tutorial	Theory	Practical	Tutorial
		-	02	-	-	01	-

Evaluation Scheme

Course Code	Course Name	In Semester Evaluation		Semester End Exam (SEE)		
U16PE606	Internet of Things Lab	Term work	Min pass	Marks	Min pass	Total (Marks)
		25	40%	-	-	25

List of Experiments

Experiments based on Course **Internet of Things (**U16PE603)

Text Book:

1 Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on Approach)", University Press 1st Edition, 2014

2 Raj Kamal, Internet of Things: Architecture and Design Principle" , ISBN-13: 978-93-5260- 522-4, McGraw Hill Education (India) 2017

References:

1 The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning

2 HakimaChouchi, "The Internet of Things Connecting Objects to the Web", ISBN 078 -1- 84821-140-7, Wiley Publications

3 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012. Michael Miller, "The Internet of Things, How Smart TVs, Smart Cars, Smart Homes, and Smart Cities are changing the World", First edition ,2015, Pearson , ISBN:978 - 93-325- 5245-6

Evaluation Scheme

- FEP assessment must be based on the overall performance of the student with every assignment graded from time to time.

- The grades will be converted to marks as per ‘credit and grading system’ manual and should be added and averaged.
- Based on the above scheme, grading and FEP assessment should be done.

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