B. V. V. Sangha's
Basaveshwar Engineering College, Bagalkote
Department of Artificial Intelligence and Machine Learning
5th Semester Scheme and Syllabus

Sl. No.	Course Category	Course Code	Course Title	Teaching-Learning Scheme				Examination Duration (Hrs/Sem.)		Total Hours	Examination Scheme and Evaluation			Credits (C)=Total Hours/30
				L Hrs/Week (Hrs/Sem.)	T Hrs/Week (Hrs/Sem.)	P Hrs/Week (Hrs/Sem.)	Term Work (TW) & Self Learning (SL), (TW+SL)	CIE	SEE		CIE Marks	SEE Marks	Total Marks	
1.	PCC	BAIA501C	Agile Methodologies	2(28)	0	0	26	3	3	60	50	50	100	2
2.	PCC	BAIA502C	Machine Learning Algorithms	3(42)	0	2	44	5	3	120	50	50	100	4
3.	IPCC	BAIA503C	Database Management System	2(28)	0	2(26)	28	5	3	90	50	50	100	3
4.	PEC	BAIA5XXE	Computer Networks	3(42)	0	0	42	3	3	90	50	50	100	3
5.	OEC	BXXXXXN	Professional Open Elective–I	3(42)	0	0	42	3	3	90	50	50	100	3
6.	PCC	BAIA505L	Machine Learning Lab	—	—	2(26)	—	3	3	60	50	50	100	2
7.	MP	BAIA506P	Mini Project	—	—	2(26)	—	3	3	60	50	50	100	2
8.	HSSM	BHSAXXXC	Environmental Studies	1(14)	0	0	13	2	1	30	50	50	100	1
9.	AEC	BHSAXXXC	Soft Skills	2(28)	0	0	26	3	3	60	50	50	100	2
10.	MC	1BHSB560M/ 1BHSC560M/ 1BHSA560M	NSS/PE/Yoga	1	0	0	14	2	—	30	25	—	25	0
			Total	18		6					425	400	825	20

Course Code		**:**	**BAIA501C**	**Agile Methodologies**	**Semester**	**:**	**5**
L:T:P		**:**	**2:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**28 Hrs.**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**26 Hrs.**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs.**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**60 Hrs.**		**Credits**	**:**	**02**

Professional Competency:

Apply Agile software development principles, project planning techniques, software design principles, testing methodologies, and Scrum practices to effectively manage software projects, develop quality software solutions, and collaborate efficiently within Agile teams.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Explain the fundamentals of software engineering, traditional software development models, Agile principles, values, roles, artifacts, and the Agile development lifecycle.

CO2: Apply Agile project planning, estimation techniques, user stories, and SOLID design principles to develop maintainable and flexible software solutions.

CO3: Utilize Agile testing, quality assurance practices, project scheduling, and estimation techniques to ensure software quality and effective project management.

CO4: Implement Scrum practices, risk management strategies, and team collaboration techniques to successfully manage and deliver Agile software projects.

Unit-I	**7 Hrs.**

Fundamentals of Software Engineering and Agile Development: Software Engineering Ethics, Essential Attributes of Good Software, Software Development Life Cycle (SDLC) , Software Process Models: Waterfall, Incremental, Evolutionary, Concurrent and Unified Process, Traditional Software Development Models vs Agile Models, Agile Manifesto: Values and Principles, Agile Roles, Artifacts, Stakeholders, and Business Benefits, Agile Development Lifecycle.

Unit-II	**7 Hrs.**

Agile Project Planning and Software Design: Agile Team Structure: Programmers, Managers and Customers, User Stories: Definition, Characteristics and Content, Agile Planning and Estimation, Planning Poker and Team Velocity, Release and Iteration Planning, Agile Development Techniques and Agile Project Management ,Software Design Fundamentals ,SOLID Design Principles: Single Responsibility Principle (SRP) ,Open-Closed Principle (OCP), Liskov Substitution Principle (LSP), Dependency Inversion Principle (DIP) ,Interface Segregation Principle (ISP).

Unit-III	**7 Hrs.**

Software Testing, Agile Testing, Quality Assurance and Project Estimation: Development Testing ,Test-Driven Development (TDD) ,Release Testing and User Testing ,Agile Testing, Software Quality and Software Standards ,Reviews and Inspections ,Quality Management in

Agile Development ,Software Measurement ,Software Pricing ,Project Scheduling ,Estimation Techniques and COCOMO Cost Modeling.

Unit-IV **7 Hrs.**

Scrum, Risk and Team Management : Scrum Framework and Need for Scrum, **Scrum Roles**: Product Owner, Scrum Master and Scrum Team, Sprint Planning, Sprint Backlog and Daily Scrum, Sprint Review and Retrospective, Burndown Charts and Project Velocity, Risk Management, Managing People and Teamwork, Scaling Agile Methods, Case Studies on Agile Project Management.

Text Books:

1. Bob Hughes, Mike Cotterell, Rajib Mall, Software Project Management, 6th Edition, McGraw Hill Education, 2018.
2. Ian Sommerville, Software Engineering, 10th Edition, Pearson Education, 2016.
3. Ken Schwaber and Mike Beedle, Agile Software Development with Scrum, Pearson Education.

Reference Books:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, Wiley India.
2. Robert C. Martin, Agile Software Development: Principles, Patterns and Practices, Prentice Hall.
3. Lisa Crispin and Janet Gregory, Agile Testing: A Practical Guide for Testers and Agile Teams, Addison-Wesley.
4. Hans van Vliet, Software Engineering: Principles and Practice, 3rd Edition, Wiley India.
5. Alistair Cockburn, Agile Software Development: The Cooperative Game, 2nd Edition, Addison-Wesley.

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs) and WKs											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1) (WK2) (WK3) (WK4)	2 (WK3) (WK4)	1 (WK5)	–	1 (WK3) (WK5) (WK6)	–	2	1	1	–	1 (WK8)	2	1	1
CO2	3 (WK1) ((WK3) WK4)	3 (WK1) (WK3) (WK4)	3	1 (WK8)	3 (WK3) (WK6)	–	–	2	1	2	1	3	3	1
CO3	3 (WK1) (WK4)	3 (WK1) (WK2) (WK3) (WK4)	2 (WK5)	3	3 (WK2) (WK3) (WK4) (WK6)	1 (WK1) (WK7)	–	1	1	2	2 (WK8)	2	3	1
CO4	2 (WK1) (WK3) (WK4)	2 (WK1) (WK3) (WK4)	2 (WK5)	2 (WK8)	2 (WK3) (WK6)	1 (WK1) (WK7)	2	3	3	3	2 (WK8)	1	2	3

Course Code		**:**	**BAIA502C**	**Machine Learning Algorithms**	**Semester**	**:**	**5**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Develop the ability to design, implement, evaluate, and optimize machine learning models using supervised learning, neural networks, Bayesian learning, instance-based learning, dimensionality reduction, and clustering techniques to solve real-world artificial intelligence and data-driven engineering problems.

Course Outcomes:

After completion of the course, students will be able to:

CO1: Apply ensemble learning techniques, regularization methods, Support Vector Machines, and class imbalance handling to supervised learning problems.

CO2: Design and implement Artificial Neural Network models using perceptron and backpropagation, and evaluate model performance using appropriate metrics and statistical methods.

CO3: Apply Bayesian learning and instance-based learning techniques for classification and regression problems.

CO4: Use dimensionality reduction and clustering techniques to analyze and interpret high-dimensional datasets.

UNIT-I	**10 Hrs.**

Ensemble Learning: Key concepts of Ensemble Learning: Weak Learners, Strong Learners
Common Types of Ensemble Learning: Bagging (Bootstrap Aggregating), Boosting,
Stacking (Stacked Generalization), Voting.

Key Ensemble Learning Algorithms: Random Forest, AdaBoost, Gradient Boosting, XGBoost (Extreme Gradient Boosting). Advantages and Disadvantages of Ensemble Learning, Applications of Ensemble Learning.

Regularization Techniques: Ridge and Lasso Regression Techniques.

Key concepts of SVM: Hyper-plane, Support Vectors, Margin, Linear SVM, Non-linear SVM. Working of SVM, Soft margin of SVM, Advantages and disadvantages of SVM, Applications of SVM.

Handling Class Imbalance: Re-sampling Techniques (SMOTE (Synthetic Minority Over-sampling Technique) and ADASYN, Cost-sensitive learning).

UNIT-II	**11 Hrs.**

Artificial Neural Networks (ANN): Introduction, Neural Network Representations, Appropriate Problems For Neural Network Learning, Perceptron, Multilayer Networks And The Back propagation Algorithm, Remarks On The Back propagation Algorithm, An Illustrative Example: Face Recognition.

Hypothesis and Performance Evaluation: Basic Performance Criterion, Precision and recall, Other ways to measure Performance, Estimating Hypothesis Accuracy, Basics of Sampling Theory, General approach for deriving confidence intervals, difference in error of two hypothesis, comparing learning algorithms.	
UNIT-III	**10 Hrs.**
Bayesian learning: Introduction, Bay's theorem, Maximum likelihood and least squared hypothesis, Maximum likelihood hypothesis for predicting probabilities, Minimum Description length principle, Bay's optimal classifier, Gibbs algorithm, Naive Bay's Classifier. An Example: Classify Text. **Instance Based Learning**: Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis function, and case based reasoning.	
UNIT-IV	**11 Hrs.**
Dimensionality Reduction: Introduction, Subset Selection, Principal Components Analysis, Factor Analysis, Multi dimensional scaling, Linear descreminant analysis, isomap, Locally Linear Embedding. **Clustering**: Introduction, Mixture Densities, K-means Clustering, Expectation Maximization Algorithm, Mixture Latent Variable models, Supervised learning after clustering, Hierarchical clustering, Choosing the number of clusters.	
Textbooks:	
1. 2. Tom Mitchell, Machine Learning, McGraw- Hill Publications, 2nd Edition, 2013. 3. Ethem Alpaydin, Introduction to Machine Learning, MIT press, Cambridge, Massachusetts, London, 2nd Edition, 2010.	
Reference Books:	
1. **2.** Trevor Hastie. Robert Tipeshirani, Jerome Fredman, Elements of Statistical Learning, Springer, 2nd Edition, 2010. **3.** Luis Pedro Coelho and Willi Richart, Building Machine Learning Systems with Python, PACKT Publication, 2nd Edition, 2013.	

Course Code	**:**	**BAIA503C**							**Semester**	**:**	**5**				
L:T:P	**:**	**2:0:2**							**Course Type**	**:**	**IPCC**				
Teaching Hours/Sem.	**:**	**28+26=54Hrs**							**CIE Marks**	**:**	**50**				
Learning (TW+SL)	**:**	**28Hrs**							**SEE Marks**	**:**	**50**				
Exam Hours	**:**	**03 Hrs**							**Total Marks**	**:**	**100**				
Total Hrs.	**:**	**90 Hrs**							**Credits**	**:**	**03**				

Database Management Systems

Course Outcomes (COs)	Programme Outcomes (POs) and WKs											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO 1	3 (WK2) (WK3)	3 (WK3)	3 (WK3) (WK4)	2 (WK4)	3 (WK5)	–	–	–	–	2 (WK9)	2 (WK11)	3	3	–
CO 2	3 (WK3) WK4)	3 (WK4)	3 (WK4)	3 (WK4)	3 (WK5)	–	–	–	1 (WK8)	2 (WK9)	2 (WK10)	3	3	2
CO 3.	3 (WK3) (WK4)	3 (WK4)	3 (WK4)	2 (WK4)	2 (WK5)	–	–	–	1 (WK8)	2 (WK9)	2 (WK10)	3	2	2
CO 4	3 (WK4) (WK5)	3 (WK4)	3 (WK4)	3 (WK4)	3 (WK5)	–	–	–	2 (WK8)	2 (WK9)	2 (WK10)	3	3	2

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Professional Competency:

Develop the ability to analyze, design, and implement robust database systems by applying fundamental concepts of data modeling, relational database design, SQL programming, normalization, transaction processing, concurrency control, recovery techniques, and database security mechanisms for efficient and reliable data management in real-world applications.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Understand the fundamental concepts of database systems, data models, database architecture, and design conceptual schemas using Entity–Relationship (ER) modeling techniques.

CO2: Apply relational model concepts, relational algebra operations, ER-to-relational mapping, and normalization techniques to design efficient and well-structured database schemas.

CO3: Construct SQL queries for data definition, data manipulation, retrieval, views, triggers, and transaction processing in relational database systems.

CO4: Analyze and evaluate concurrency control mechanisms, recovery techniques, and database security models to ensure consistency, reliability, and secure access in database systems.

UNIT–I	**07 Hrs.**

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.

Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. **Conceptual Data Modelling using Entities and Relationships:** Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams,Specialization and Generalization.

UNIT–II	**07 Hrs.**

Relational Model: Relational Model Concepts, Relational Model Constraints and relational

database schemas, Update operations, transactions, and dealing with constraint violations.

Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.

Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

UNIT-III	**07 Hrs.**

SQL: SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL

SQL: Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL.

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

UNIT-IV	**07 Hrs.**

Concurrency Control in Databases: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.

Database Recovery and Security: Recovery Concepts, Types of Failures, Log-Based Recovery Techniques (Deferred Update and Immediate Update), Checkpoints, Shadow Paging, Database Backup and Restore.

Database Security: Security Threats, Authorization, Access Control, GRANT and REVOKE Statements, Roles and Privileges, Database Auditing.

Text Books:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill
3. Seema. Acharya and Subhashini. C, “Big Data and Analytics”, 1st Edition, Wiley India, 2015

Reference Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill Education, 7th Edition, 2019.
2. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, "Database Systems: The Complete Book", Pearson Education, 2nd Edition.
3. Jeffrey A. Hoffer, V. Ramesh, Heikki Topi, "Modern Database Management", Pearson, 13th Edition, 2019.
4. Ivan Bayross, "SQL, PL/SQL: The Programming Language of Oracle", BPB Publications.
5. Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide", O'Reilly Media, 3rd Edition.

6. Eric Redmond, Jim R. Wilson, "Seven Databases in Seven Weeks", Pragmatic Bookshelf, 2nd Edition.

Lab Assignments

Sl. No	Assignments
1	Create a table called Employee & execute the following. Employee(EMPNO,ENAME,JOB, MANAGER_NO, SAL, COMMISSION) 1. Create a user and grant all permissions to theuser. 2. Insert the any three records in the employee table contains attributes EMPNO,ENAME JOB, MANAGER_NO, SAL, COMMISSION and use rollback. Check the result. 3. Add primary key constraint and not null constraint to the employee table. 4. Insert null values to the employee table and verify the result.
2	Create a table called Employee that contain attributes EMPNO,ENAME, JOB, MGR,SAL & execute the following. 1. Add a column commission with domain to the Employeetable. 2. Insert any five records into the table. 3. Update the column details of job 4. Rename the column of Employ table using alter command. 5. Delete the employee whose Empno is 105.
3	Queries using aggregate functions(COUNT,AVG,MIN,MAX,SUM),Group by,Orderby. Employee(E_id, E_name, Age, Salary) 1. Create Employee table containing all Records E_id, E_name, Age, Salary. 2. Count number of employee names from employeetable 3. Find the Maximum age from employee table. 4. Find the Minimum age from employeetable. 5. Find salaries of employee in Ascending Order. 6. Find grouped salaries of employees.
4	Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old & new Salary. CUSTOMERS(ID,NAME,AGE,ADDRESS,SALARY)
5	Create cursor for Employee table & extract the values from the table. Declare the variables ,Open the cursor & extrct the values from the cursor. Close the cursor. Employee(E_id, E_name, Age, Salary)
6	Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped.

7	Create a table called **Bank_Account** and execute the following: **Bank_Account(Account_No, Customer_Name, Balance, Branch)** 1. Create a database user and grant privileges using **GRANT ALL PRIVILEGES** to the user. 2. Insert any three records into the Bank_Account table and demonstrate **COMMIT and ROLLBACK**, and verify the results. 3. Add **PRIMARY KEY** and **NOT NULL** constraints to the table. 4. Insert NULL values and verify constraint enforcement. 5. Simulate a failed withdrawal transaction (Balance should not become negative) and demonstrate **ROLLBACK**. 6. Demonstrate **log-based recovery (immediate update concept)** by updating balance and maintaining a transaction log table. 7. Create a simple **audit log using trigger** to record INSERT/UPDATE/DELETE operations performed on the table. 8. Revoke user permissions using **REVOKE command** and verify restricted access.

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Programme Outcomes (POs) and WKs											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1) (WK2) (WK3) (WK4)	3 (WK1) (WK2) (WK3) (WK4)	2 (WK3) (WK4)	1 (WK8)	2 (WK2) (WK6)	–	–	–	1	–	2 (WK8)	3	2	2
CO2	3 (WK1) (WK2) (WK3) (WK4)	3 (WK1) (WK2) (WK3) (WK4)	3 (WK3) (WK4) (WK5)	1 (WK8)	2 (WK2) (WK6)	–	–	–	1	–	2 (WK8)	3	3	3
CO3	2 (WK2) (WK3) (WK4)	3 (WK1) (WK2) (WK3) (WK4)	2 (WK5)	2 (WK8)	3 (WK2) (WK6)	–	–	–	2	1	2 (WK8)	2	3	3
CO4	2 (WK2, WK3, WK4)	3 (WK1) (WK2) (WK3) (WK4)	2 (WK5)	3 (WK8)	3 (WK2) (WK6)	1 (WK1) (WK5) (WK7)	1 (WK9)	1	1	1	2 (WK8)	2	3	3

Course Code		**:**	**BAIA504E**	**Computer Networks**	**Semester**	**:**	**5**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs.**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs.**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs.**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs.**		**Credits**	**:**	**03**

Professional Competency:

Analyze, design, and manage computer networks by applying networking protocols, routing techniques, communication standards, and network security principles.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Understand and Contrast the concept of computer network concepts with it types, topologies, transmission media, layered protocols and standards, port and IP address, network models and discuss the functionalities of each layer in the models.

CO2: Discuss and Analyze flow control and error control mechanisms and apply them using standard data link layer protocols.

CO3: Analyze and apply various routing algorithms to find shortest paths for packet delivery.

CO4: Explain the details of Transport Layer Protocols (UDP, TCP) and suggest appropriate protocol in reliable/unreliable communication.

CO5: Analyze the features and operations of various application layer protocols such as HTTP, DNS,SMTP and need of network security

UNIT-I	**10 Hrs**

Introduction to Network and Communication: Definition, **Network topology:** Mesh (advantages and disadvantages), Star (advantages and disadvantages), Ring (advantages and disadvantages). **Types of Networks based on size:** LAN, WAN, MAN. **Classes of transmission media:** Guided (wired)-Twisted pair cable, Co axial cable, Fiber-optic cable. Unguided (wireless)-Free space. **Propagation modes:** Switching (switched networks) Circuit switched networks, Packed switched network-datagram circuit network, Virtual circuit network, Message switched network. **OSI (Open System Interconnection):** Seven layers, How data is referred to in the OSI model? Interaction between layers

in the OSI model, advantages of OSI model, differences between OSI and TCP/IP models. Port number, Port range groups. **IP address:** Types of IPaddresses-IPv4, IPv6, IP address format, classes of IP address. **Protocols and Standards:** The key elements of a protocol, Standard Creation committees.
UNIT–II **11 Hrs**
Data link layer: Data link layer services and flow control techniques. Design issues. **Framing:** Character count, Flag bytes with byte stuffing, Starting and ending flags, With bit stuffing. **Elementary data link protocols:** Utopian simplex protocol-, a simplex stop and wait protocol for an error-free channel, Noisy channel. **Sliding Window protocols***:* Stop-and-Wait Automatic Repeat Request, Go-Back-N Automatic Repeat Request. **Controlled Access Protocols**: Reservation, Polling, And Token Passing. **Error Detection**: Simple Parity check, Two-dimensional Parity check, Checksum, Cyclic redundancy check. **Multiple Access Protocols:** ALOHA, CSMA, CSMA/CD, CSMA/CA, Collision free protocols.
UNIT-III **10 Hrs**
Network Layer: Services, Routing algorithms- The Optimality Principal, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical routing, Congestion Control Algorithms. **Transport layer:** Services, advantage and disadvantages, responsibility of transport layer, Elements of Transport Protocols, Congestion control, The Internet Transport Protocols (TCP) and User Datagram Protocol (UDP), Differences between TCP and UDP and features of network layer. CIDR, Sub netting, Super Netting, ARP, RARP.
UNIT-IV **11 Hrs**
The application Layer: Functions of application layer, Application layer services, protocols. **DNS (Domain Name System):**Domain Name Space, Distribution of Name Space, DNS in the internet, resolution, applications of DNS. **Electronic mail***:* Components of Email System, E-Mail Protocol, SMTP (Simple Mail Transfer Protocol), POP(Post Office Protocol), IMAP(Interne Mail Access Protocol). Architecture of WWW. **Web Documents:** Static, Dynamic, Active Static. **Network Security:** Goals of Network Security, Security Services, Types of Network Security and classification of Security Attacks.
Text Books:
1. Andrew. S. Tanenbaum, David. J. Wetherall, "Computer Networks", Pearson Education, 5th Edition.
Reference Books:
1. Behrouz. A. Forouzan, "Data Communications and Networking", Tata Mc Graw Hill, 4th Edition. 2. Kurose and Ross, "Computer Networking-A Top - Down approach", Pearson, 5th Edition.

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (Cos)	Programme Outcomes (POs) and WKs											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK3)	3 (WK2)	–	–	2 (WK6)	–	–	–	–	–	2 (WK6)	3	–	–
CO2	3 (WK3)	3 (WK2)	–	–	3 (WK6)	–	–	–	–	–	2 (WK6)	3	–	–
CO3	3 (WK3)	3 (WK2)	–	–	3 (WK6)	–	–	–	–	–	2 (WK6)	3	–	–
CO4	3	3	–	–	3	–	–	–	–	–	2	3	–	2

	(WK3)	(WK2)			(WK6)						(WK6)			

Course Code	:	BAIA505L	Machine Learning Lab.	Semester	:	5
L:T:P	:	0:0:2		Course Type	:	PCC
Hours/Sem. Teaching	:	26 Hrs.		CIE Marks	:	50
Hours/Sem. Learning (TW+SL)	:	00 Hrs.		SEE Marks	:	50
Hours/Sem. Exam	:	04 Hrs.		Total Marks	:	100
Hours/Sem. Total Hrs.	:	30 Hrs.		Credits	:	01

Professional Competency:

Develop the ability to design, implement, evaluate, and optimize machine learning algorithms using supervised learning, neural networks, Bayesian learning, instance-based learning, dimensionality reduction, clustering, and ensemble techniques to solve complex real-world artificial intelligence and data-driven engineering problems.

Course Outcomes:

After completion of the course, students will be able to:

CO1: Apply supervised learning techniques such as Support Vector Machines (SVM), ensemble learning algorithms, and regularization methods to solve classification and prediction problems on real-world datasets.

CO2: Design and implement Artificial Neural Network (ANN), Bayesian learning, and instance-based learning models for classification and regression tasks, and evaluate their performance using appropriate metrics.

CO3: Apply dimensionality reduction and clustering techniques, including PCA, Kernel PCA, LDA, K-Means, and DBSCAN, to analyze, preprocess, and interpret high-dimensional data.

CO4: Develop and compare hybrid machine learning solutions by integrating feature engineering, dimensionality reduction, clustering, ensemble learning, and neural network techniques to solve real-world AI applications such as image classification, text classification, customer segmentation, anomaly detection, and sentiment analysis.

SL. NO.	List of Assignments
1.	**PCA + SVM for Image Classification** **Problem Statement:**

	Design a system that uses **Principal Component Analysis (PCA)** for dimensionality reduction and **Support Vector Machine (SVM)** for classification of high-dimensional image data. **Objectives:** • Reduce image dimensionality using PCA. • Train an SVM classifier on reduced feature vectors. • Evaluate classification accuracy and computational efficiency. **Dataset:** MNIST Handwritten Digits Dataset (Kaggle/UCI)
2.	**Clustering + ANN for Customer Behavior Prediction** **Problem Statement:** Cluster customers into meaningful groups using **K-Means Clustering** and use an **Artificial Neural Network (ANN)** to predict future purchase behavior. **Objectives:** • Perform customer segmentation using clustering. • Train an ANN model for customer behavior prediction. • Compare prediction performance with and without clustering. **Dataset:** Mall Customer Segmentation Dataset (Kaggle)
3.	**Feature Reduction → Ensemble Learning Pipeline** **Problem Statement:** Develop a machine learning pipeline using **PCA/LDA** for feature reduction followed by **Random Forest** and **Gradient Boosting** classifiers. **Objectives:** • Reduce feature dimensionality. • Train ensemble learning models. • Compare classification performance before and after feature reduction. **Dataset:** Breast Cancer Wisconsin Dataset (UCI)
4.	**Real-Time Anomaly Detection (Clustering + Ensemble)** **Problem Statement:** Develop an anomaly detection system using **DBSCAN clustering** and **Isolation Forest** for identifying abnormal data instances. **Objectives:** • Detect outliers using density-based clustering. • Improve anomaly detection using ensemble learning. • Evaluate fraud detection performance. **Dataset:** Credit Card Fraud Detection Dataset (Kaggle)
5.	**Comparative Study: SVM vs ANN vs Ensemble vs Bayesian** **Problem Statement:** Implement and compare **Support Vector Machine (SVM), Artificial Neural Network (ANN), Naïve Bayes, and Ensemble Learning** algorithms on the same dataset. **Objectives:** • Compare multiple machine learning models. • Evaluate using Accuracy, Precision, Recall, F1-Score, and Training Time. • Identify the best-performing algorithm. **Dataset:** Iris Dataset (UCI) or Wine Dataset (UCI)
6.	**Kernel PCA + SVM for Nonlinear Data** **Problem Statement:** Apply **Kernel PCA** for nonlinear feature extraction and classify data using **Support**

	Vector Machine (SVM). **Objectives:** • Perform nonlinear dimensionality reduction. • Train SVM on transformed features. • Compare results with conventional PCA. **Dataset:** Two Spirals Dataset (Synthetic) / Make_Moons Dataset (Scikit-learn)
7.	**Clustering-Based Preprocessing for ANN** **Problem Statement:** Use **K-Means Clustering** as a preprocessing step to improve the classification performance of an **Artificial Neural Network (ANN).** **Objectives:** • Cluster input data before training. • Train ANN using clustered data. • Evaluate performance improvement. **Dataset:** Human Activity Recognition (UCI HAR) Dataset
8.	**Ensemble + Feature Selection for Text Classification** **Problem Statement:** Develop a text classification system using **TF-IDF**, **feature selection**, and **ensemble learning algorithms** for sentiment analysis. **Objectives:** • Extract textual features using TF-IDF. • Perform feature selection. • Train and compare ensemble classifiers. **Dataset:** IMDB Movie Reviews Dataset
9.	**Hybrid Model: Bayesian + Ensemble Learning** **Problem Statement:** Develop a hybrid classification model by combining **Naïve Bayes** with **ensemble learning techniques** to improve probabilistic predictions. **Objectives:** • Implement Bayesian classification. • Integrate ensemble methods for enhanced prediction. • Evaluate spam detection performance. **Dataset:** SMS Spam Collection Dataset (UCI)
10.	**Dimensionality Reduction Impact Study** **Problem Statement:** Analyze the impact of different dimensionality reduction techniques (**PCA, t-SNE, and UMAP**) on the performance of **SVM** and **ANN** classifiers. **Objectives:** • Apply multiple dimensionality reduction techniques. • Compare classifier performance. • Analyze computational efficiency and visualization quality. **Dataset:** Fashion-MNIST Dataset

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Programme Outcomes (POs) and WKs											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK2) (WK3)	3 (WK3)	3 (WK3) (WK4)	2 (WK4)	3 (WK5)	–	–	–	–	2 (WK9)	1 (WK11)	3	3	–
CO2	3 (WK3) (WK4)	3 (WK4)	3 (WK4)	3 (WK4)	3 (WK5)	–	–	–	1 (WK8)	2 (WK9)	2 (WK10)	3	3	2
CO3	3 (WK4) (WK5)	3 (WK4)	3 (WK4)	3 (WK4)	3 (WK5)	–	–	–	1 (WK8)	2 (WK9)	2 (WK10)	3	3	2
CO4	3 (WK4) (WK5)	3 (WK4)	3 (WK4)	3 (WK4)	3 (WK5)	–	–	–	2 (WK8)	2 (WK9)	2 (WK10)	3	3	3

6th Semester Scheme and Syllabus

Sl. No.	Course Category	Course Code	Course Title	Teaching-Learning Scheme				Examination Duration (Hrs/Sem.)		Total Hours	Examination Scheme and Evaluation			Credits (C)=Total Hours/30
				L Hrs/Week (Hrs/Sem.)	T Hrs/Week (Hrs/Sem.)	P Hrs/Week (Hrs/Sem.)	Term Work (TW) & Self Learning (SL), (TW+SL) Hrs/Sem.	CIE	SEE		CIE Marks	SEE Marks	Total Marks	
1.	PCC	BAIA601C	Natural Language Processing	3(42)	0	0	28	3	3	90	50	50	100	3
2.	PCC	BAIA602C	Advanced AI and ML	3(42)	0	0	42	3	3	90	50	50	100	3
3.	PCC	BAIA603C	Big Data Analytics	3(42)	0	0	42	3	3	90	50	50	100	3
4.	IPCC	BAIA604C	Cyber Security Tools & Techniques	2(28)	0	2(26)	28	5	3	90	50	50	100	3
5.	PEC	BAIA6XXE	Professional Elective Course	3(42)	0	0	42	3	3	90	50	50	100	3
6.	OEC	BXXX6XXN	Professional Open Elective–II	3(42)	0	0	42	3	3	90	50	50	100	3
7.	PCC	BAIA606L	Advanced AI and ML lab	0	0	2(26)	0	2	2	30	50	50	100	1
8.	HSSM	BHSA6XXC	Indian Knowledge System	1(14)	0	0	13	2	1	30	50	50	100	1
9.	MC	BHSB660M/ BHSC660M/ BHSA660M	NSS/PE/Yoga	1(14)	0	0	14	2	—	30	25	—	25	0
Total				19		4					425	400	825	20

Course Code		**:**	**BAIA601C**	**Natural Language Processing**	**Semester**	**:**	**6**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Develop the ability to analyze, design, and implement Natural Language Processing (NLP) techniques using statistical, probabilistic, and machine learning approaches for understanding, processing, and extracting meaningful information from natural language text to solve real-world AI applications.

Course Outcomes:

After completion of the course, students will be able to:

CO1: Understand the foundational concepts of Natural Language Processing including empirical laws, spelling correction, n-gram models, and morphological analysis.

CO2: Apply probabilistic models like HMM and PCFG for part-of-speech tagging and syntactic parsing of natural language text. Apply statistical and machine learning algorithms to natural language processing.

CO3: Analyze and implement semantic models such as word embeddings, topic models, and lexical semantics for meaning representation and disambiguation.

CO4: Design and evaluate NLP applications such as entity linking, text summarization, and sentiment analysis using modern approaches.

UNIT-I	**10 Hrs.**

Introduction to NLP: Empirical Laws, Text Processing. **Spelling Correction**: Edit Distance, Weighted Edit Distance, Other Variations, Noisy Channel Model for Spelling Correction. **N-Gram Language Models:** Evaluation of Language Models, Basic Smoothing. **Computational Morphology**: Finite State Methods for Morphology.

UNIT-II	**11 Hrs.**

Introduction to POS Tagging: Hidden Markov Models for POS Tagging, Viterbi Decoding for HMM, Parameter Learning. **Syntactic Parsing:** Introduction, Parsing, CKY, PCFGs, PCFGs - Inside-Outside Probabilities. **Dependency Grammars and Parsing**: Introduction, Transition Based Parsing: Formulation and learning.

UNIT-III	**10 Hrs.**

Distributional Semantics: Introduction, Distributional Models of Semantics, Applications, Structured Models, Word Embeddings. **Lexical Semantics:** Introduction, Wordnet. Word Sense Disambiguation,

Novel Word Sense detection. **Topic Models:** Introduction, Latent Dirichlet Allocation: Formulation, Gibbs Sampling for LDA, Applications.	
UNIT-IV	**11 Hrs.**
Entity Linking: Information Extraction, Relation Extraction, Distant Supervision. **Text Summarization:** LEXRANK, Optimization Based Approaches for Summarization, Summarization Evaluation. **Text Classification:** Sentiment Analysis, Affective Lexicons, Learning Affective Lexicons, Computing with Affective Lexicons, Aspect Based Sentiment Analysis.	
Textbooks:	
2. Dan Jurafsky and James Martin. "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition". Prentice Hall, 2nd Edition, 2009. 3. Chris Manning and Hinrich Schütze. "Foundations of Statistical Natural Language Processing", MIT Press, Cambridge, May 1999.	
Web Links and Video Lectures:	
2. **NPTEL Video Link: https://nptel.ac.in/courses/106105158**	

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CO2	3 (WK2) (WK3)	3 (WK3)	3 (WK3) (WK4)	2 (WK4)	2 (WK5)	–	–	–	–	2 (WK9)	1 (WK11)	3	2	–
CO3	3 (WK3) (WK4)	3 (WK4)	3 (WK4)	3 (WK4)	2 (WK5)	–	–	–	1 (WK8)	2 (WK9)	2 (WK10)	3	2	–
CO4	3 (WK3) (WK4)	3 (WK4)	3 (WK4)	3 (WK4)	3 (WK5)	–	–	–	1 (WK8)	2 (WK9)	2 (WK10)	3	3	2

Course Code		**:**	**BAIA602C**	**Advanced AI and ML**	**Semester**	**:**	**6**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Design, develop, and evaluate deep learning-based intelligent systems using TensorFlow and modern neural network architectures for solving real-world AI applications.

Course Outcomes:

After completion of the course, students will be able to:

CO1: Recognize the characteristics of deep learning models that are useful to solve real-world problems.

CO2:Remember architectures and optimization methods for deep neural network training

CO3: Design and deploy simple Tensor Flow-based deep learning solutions to classification problems

CO4: Design the test procedures to assess the efficacy of the developed model.

UNIT–I	**10 Hrs.**

Fundamentals of deep learning: What is Deep Learning, Applications, Weights and Activation functions, Decision Surfaces, Linear Classifiers, Linear Machines with Hinge Loss, Data Preprocessing, Image augmentation in Open CV. What are convolutional neural network and tensorflow, Convolutional layer, Pooling layer, How to create the layers in Python. **Conv Nets:** Basic concepts of Convolutional Neural Networks starting from filetering. Convolution and pooling operation and arithmatics of these.

Revisiting ConvNet Architectures: Discussions on famous convnet architectures - AlexNet, ZFNet, VGG, C3D, GoogLeNet, ResNet, MobileNet-v1, MobileNet-v2, EfficientNet, GhostNet

UNIT–II	**11 Hrs.**

Transfer learning, RCNN (Fast RCNN, Faster RCNN, Mask RCNN), Revisiting Gradient Descent, Momentum Optimizer, RMS Prop, Adam, Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization, Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN.

Representation and Generative Learning: Autoe ncoder Architecture-Implementing an Auto encoder in Tensor Flow –Denoising Sparsity in Auto encoders Models for Sequence Analysis, Generative adversarial Networks, Simple example with MNIST dataset, Limitation of GAN and Deep Convolutional GANs.

UNIT-III	11 Hrs.
Classical Supervised Tasks with Deep Learning, Image Denoising, Semantic Segmentation, Object Detection etc. Recurrent Architectures, Transformers, Vision Transformers: Introduction to Recurrent Neural Networks (RNNs), The Architecture of a Traditional RNN, How does Recurrent Neural Networks work? Back propagation Through Time (BPTT), issues of Standard RNNs, RNN Applications, Basic Python Implementation (RNN with Keras), Recurrent Neural Networks-Vanishing Gradients, Long Short-Term Memory (LSTM) Units- Tensor Flow Primitives for RNN Models-Augmenting Recurrent Networks with Attention, Applications of LSTM.	
UNIT-IV	**10 Hrs.**
Deep Learning applications of Reinforcement Learning and NLP: Key elements of Reinforcement Learning, What are the types of deep reinforcement learning in NLP? Open AI Gym Toolkit, How is Deep Learning applied to RL, Robotic Manipulation using Deep RL, Application of Deep learning to Natural Language Processing, Automatic Language Translation, Automatic Text Classification, RCNN and YOLO architectures, fully convolutional segmentations, Mask-RCNNs	
Text Books:	
1. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithm", O'Reilly, 2017. 2. Ian Good fellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.	
Reference Books:	
1. Aurélien Géron, "Hands-On Machine Learning with Scikit- Learn and Tensor Flow", O'Reilly, 2017. 2. Nikhil Ketkar, "Deep Learning with Python: A Hands-on Introduction", Apress, 2017.	

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	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK2) (WK3) (WK4)	2 (WK2) (WK3) (WK4)	–	–	1 (WK2)	–	–	–	–	–	1 (WK8)	3	2	–
CO2	3 (WK2) (WK3) (WK4)	3 (WK2) (WK3) (WK4)	1 (WK5)	2 (WK8)	2 (WK2) (WK6)	–	–	–	–	–	1 (WK8)	3	3	–
CO3	2 (WK2) (WK3) (WK4)	2 (WK2) (WK3) (WK4)	3 (WK5)	2 (WK8)	3 (WK2) (WK6)	–	–	–	1	–	1 (WK8)	2	3	1
CO4	2 (WK2) (WK3)	3 (WK2) (WK3)	2 (WK5)	3 (WK8)	3 (WK2) (WK6)	1 (WK5) (WK7)	–	–	1	–	2 (WK8)	2	3	2

	(WK4)	(WK4)												

Course Code		**:**	**BAIA603C**	**Big Data Analytics**	**Semester**	**:**	**6**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Apply Big Data analytics techniques, Hadoop ecosystem tools, and NoSQL databases to store, process, analyze, and interpret large datasets for developing efficient, scalable, and data-driven solutions to engineering problems.

Course Outcomes:

After completion of the course, students will be able to:

CO1: Analyze the characteristics of digital data and it's challenges in Big data environment.

CO2: Analyze the challenges of big data analytics and its terminologies that prevent businesses from capitalizing.

CO3: Build meaningful conversations on Big Data and analytics using Hadoop.

CO4: Identify suitable types of NoSQL databases to solve complex engineering problems.

CO5: Apply Hive and Pig tools on structured data for processing and analyzing.

UNIT-I	**10 Hrs.**

Types of Digital Data: Classification of Digital Data – Structured Data, Semi-Structured Data, and Unstructured Data. Introduction to Big Data: Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, definition of Big Data, other Characteristics of Data Which are not Definitional Traits of Big Data, Need of Big Data, traditional Business Intelligence (BI) versus Big Data, A Typical Data Warehouse Environment, A Typical Hadoop Environment, Today's trend, Evolution in the Realms of Big Data.

Big Data Analytics: Meaning of Big Data Analytics, classification of Analytics, Greatest Challenges that Prevent Businesses from Capitalizing on Big Data, Top Challenges Facing Big Data, Importance of Big Data Analytics, Technologies to Meet the Challenges Posed by Big Data, Data Science, Data Scientist. Terminologies Used in Big Data Environments, Basically Available Soft State Eventual Consistency (BASE), Few Top Analytics Tools.

UNIT-II	**11 Hrs.**

Big Data Technology Landscape - NoSQL (Not Only SQL) and Hadoop.

NoSQL (Not Only SQL) – use of NoSQL, Types of NoSQL databases, benefits of NoSQL, Advantages of NoSQL, NoSQL Vendors, SQL Versus NoSQL, NewSQL, Comparison of SQL, NoSQL, and NewSQL.

Hadoop: Features of Hadoop, Key advantages of Hadoop, Versions of Hadoop - Hadoop 1.0, Hadoop 2.0, Overview of Hadoop Ecosystems, Hadoop Versus, SQL, Integrated Hadoop systems offered by leading market vendors, Cloud based Hadoop solutions. Introducing Hadoop, Hadoop vs RDBMS, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop, Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System), Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem.

UNIT-III	**10 Hrs.**

Introduction to MongoDB: Introduction MongoDB, Terms Used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language.- Insert, Save, Update, Remove, find methods, Dealing with NULL values, Count, Limit, Sort and Skip Methods.

Introduction to Cassandra: An Introduction, Features of Cassandra, CQL Data types, CQLSH, Keyspaces, CRUD (Create, Read, Update and Delete) Operations, Collections.

UNIT-IV	**11 Hrs.**

Hive: Hive Architecture, Hive Data Types, Hive File Formats, Hive Query Language (HQL), RCFile Implementation, SerDe, and User-defined Function (UDF).

Introduction to Pig: The Anatomy of Pig, Pig on Hadoop, Pig Philosophy. **Use Case for Pig:** ETL Processing, Pig Latin Overview, Data Types in Pig, Running Pig, Execution Modes of Pig, Relational Operators, Eval Function,Complex Data Types.

Textbooks:

1. Seema. Acharya and Subhashini. C, “Big Data and Analytics”, 1st Edition, Wiley India, 2015 (Chapters 1,2,3,4,5,6,7,9,10).

Reference Books:

1. Bart. Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, 1 st Edition, Wiley, 2014.
2. DT Editorial Services, “Big Data: Black Book, Comprehensive Problem Solver”, 1 st Edition, Dreamtech Press, 2016.
3. Tom. White, “Hadoop – The Definitive Guide”, 3rd Edition, O’Reilly, 2012.
4. Alex Holmes, “Hadoop in Practice”, 2nd Edition, Dreamtech Press India Pvt. Ltd, 2014.
5. Dayong. Du, “Apache Hive Essentials”, 2 nd Edition, Packt Publishing Limited, 2018.
6. Alan. Gates, “Programming Pig”, 2nd Edition, Shroff/O’Reilly, 2016.
7. Alan. Gates, “Programming Pig: Dataflow Scripting with Hadoop”, 2 nd Edition, Shroff/O’Reilly, 2016.

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CO2	3 (WK2) (WK3)	3 (WK3)	2 (WK3) (WK4)	–	2 (WK5)	–	–	–	–	2 (WK9)	1 (WK11)	3	2	–
CO3	3 (WK3) (WK4)	3 (WK4)	3 (WK4)	2 (WK4)	2 (WK5)	–	–	–	1 (WK8)	2 (WK9)	2 (WK10)	3	2	–
CO4	3 (WK3) (WK4)	3 (WK4)	3 (WK4)	2 (WK4)	3 (WK5)	–	–	–	1 (WK8)	2 (WK9)	2 (WK10)	–	3	2

Course Code		**:**	**BAIA604C**	**Cyber Security Tools and Techniques**	**Semester**	**:**	**6**
L:T:P		**:**	**2:0:2**		**Course Type**	**:**	**IPCC**
Hours/Sem.	**Teaching**	**:**	**28 +26 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**28 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**08 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Develop the ability to identify, analyze, and mitigate cyber security threats by applying ethical hacking techniques, penetration testing tools, virtualized environments, Linux-based security utilities, and vulnerability assessment frameworks to secure modern computing systems and networks.

Course Outcomes:

After completion of the course, students will be able to:

CO1: Apply cybersecurity principles, security controls, cyber ethics, and AI-based techniques to identify and mitigate cyber threats.

CO2: Examine network traffic, vulnerabilities, and security incidents using Kali Linux, Nmap, and Wireshark.

CO3: Perform web application security assessment using Burp Suite to identify common vulnerabilities.

CO4: Evaluate adversarial machine learning attacks, LLM security risks, and AI defence mechanisms using the Adversarial Robustness Toolbox (ART) and AI security frameworks.

UNIT-I	**10 Hrs.**

Foundations of Cybersecurity and the AI Connection

Cybersecurity Fundamentals: What is cybersecurity and why it matters; the CIA triad (Confidentiality, Integrity, Availability) and its opposites. Core terms: threat, vulnerability, exploit, risk, and attack surface — definitions and how they relate. Types of cyber attacks: malware (virus, worm, trojan, ransomware, spyware), phishing and social engineering, DoS/DDoS, man-in-the-middle (MITM), and password attacks. Security controls and services: authentication, authorization, encryption (overview), firewalls, IDS/IPS, and antivirus. Ethics and law: responsible/ethical hacking, consent and scope, and cyber-law basics.

AI and Cybersecurity: The Combined View (the heart of this course): Role of AI in cybersecurity: how AI strengthens defence — detecting spam, phishing, malware, and network intrusions; automating alert triage; and predicting threats. Where it is used today: AI inside antivirus/EDR, email security, fraud detection, and Security Operations Centres (SOC). Security of AI: why AI/ML systems are themselves targets — an introduction to adversarial threats (poisoning, evasion) and data-privacy risks.

The road ahead (2026 onwards): attackers and defenders both using AI ("AI vs AI"); agentic and autonomous security operations; the rapid rise of LLM/Generative-AI security; and why securing AI is becoming as important as using it.

UNIT-II	11 Hrs.

Network Security & Analysis using Kali Linux, Nmap & Wireshark:

Theoretical Concepts: Networking fundamentals: the OSI 7-layer model, the TCP/IP model, and data encapsulation. Protocols and ports: HTTP/HTTPS, DNS, TCP, UDP, ICMP, ARP; the idea of well-known ports. Network packets: packet structure (headers and payload); what network traffic reveals. Common network attacks: packet sniffing, IP/ARP spoofing, MITM, session hijacking, and network DoS. Network security devices: firewall, proxy, VPN, and IDS/IPS - including the open-source Snort as a classic example. Traffic/packet analysis and the role of AI/ML in network intrusion detection (NIDS).

Kali Linux, Nmap & Wireshark: Kali Linux - the free security platform: what it is and why it bundles the security tools; running it in a virtual machine or live USB (these tools also run on Windows/Linux directly). Nmap - introduction and installation: what network scanning is and why it is the first step. Nmap - basic to intermediate use: host discovery, port scanning, and common scan types (SYN scan, service/version detection, OS detection) and reading the results. Wireshark - introduction and installation: key features and the capture library (Npcap/libpcap); permissions to capture. Wireshark - basic to intermediate use: choosing an interface and capturing; the three panes; capture vs. display filters (ip.addr, tcp.port, http, dns); "Follow TCP/HTTP Stream" and spotting plaintext credentials.

UNIT-III	10 Hrs.

Web Application Security & Testing using Burp Suite:

Theoretical Concepts: Web-application architecture: client–server model, HTTP/HTTPS request–response, methods (GET/POST), and status codes. Sessions, cookies, and authentication; the idea of same-origin and why state matters. The OWASP Top 10: what it is and why it is the industry reference for web risks. Key web vulnerabilities in detail: SQL injection, Cross-Site Scripting (XSS), CSRF, broken authentication, and security misconfiguration. Secure practices: input validation, output encoding, and HTTPS/TLS. Role of AI/ML in web security: phishing and malicious-URL detection, and ML-assisted Web Application Firewalls.

Burp Suite: Introduction: what Burp Suite is; Community vs. Professional editions; the intercepting-proxy concept. Main components: Proxy, Repeater, Intruder, Decoder, Comparer, and the Scanner (overview). Installation and setup: installing Burp, configuring the browser proxy, and adding the CA certificate to intercept HTTPS. Basic use: intercepting a request, reading the HTTP history, and forwarding or dropping traffic.

UNIT-IV	11 Hrs.

Securing AI Systems: Adversarial ML & LLM Security using ART

Theoretical Concepts: Why AI must be secured: AI/ML as a new attack surface; the idea of a secure AI lifecycle. Adversarial ML attacks: evasion (adversarial examples, the FGSM idea), data poisoning, model extraction/stealing, and membership-inference/privacy attacks. Defences for AI models: adversarial training, robust models, input sanitisation, and privacy techniques (overview). LLM and Generative-AI security for LLM Applications: prompt injection and jailbreaks, sensitive-information is closure, system-prompt leakage, and vector/embedding (RAG) weaknesses. Frameworks and governance:

MITRE ATLAS, the NIST AI Risk Management Framework, data-protection laws (India's DPDP Act, GDPR), and responsible disclosure.

Adversarial Robustness Toolbox (ART): Introduction: what ART is, the frameworks it supports, and the attacks/defences it can demonstrate; (related tool: Garak for scanning LLMs). Installation: installing ART with pip inside Google Colab; the required libraries. Basic use: wrapping a trained image classifier and running an evasion attack (e.g., FGSM) to make it misclassify an input. Intermediate use: trying a simple poisoning attack and then applying a defence (adversarial training), and reading the change in model accuracy.

Textbooks:

1. Alessandro Parisi, Hands-On Artificial Intelligence for Cybersecurity, Packt Publishing, 2019.
2. Dr. Nilakshi Jain, Artificial Intelligence: Making a System Intelligent (As per AICTE), Wiley Publication, 2019.
3. Clarence Chio & David Freeman, Machine Learning and Security, O'Reilly Media, 2018.
4. Chris Sanders, Practical Packet Analysis (Wireshark), 3rd Edition, No Starch Press, 2017.
5. Dafydd Stuttard & Marcus Pinto, The Web Application Hacker's Handbook, 2nd Edition, Wiley, 2011.

Reference Textbooks:

1. Georgia Weidman, Penetration Testing: A Hands-On Introduction to Hacking, No Starch Press, 2014.
2. Steve Wilson, The Developer's Playbook for Large Language Model Security, O'Reilly Media, 2024.
3. Leandros Maglaras & Helge Janicke (Eds.), Artificial Intelligence and Cybersecurity: Advances and Challenges, CRC Press

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CO1	3 (WK2) (WK3)	2 (WK3)	1 (WK3)	–	2 (WK5)	–	–	2 (WK8)	–	2 (WK9)	1 (WK11)	3	2	–
CO2	3 (WK3) (WK4)	3 (WK4)	2 (WK4)	3 (WK4)	3 (WK5)	–	–	1 (WK8)	1 (WK9)	2 (WK10)	2 (WK11)	3	3	2

CO3	2 (WK3) (WK4)	3 (WK4)	3 (WK4)	3 (WK4)	3 (WK5)	–	–	1 (WK8)	2 (WK9)	2 (WK10)	2 (WK11)	3	3	2
CO4	3 (WK4) (WK5)	3 (WK4)	2 (WK4)	3 (WK4)	3 (WK5)	2 (WK6)	–	2 (WK8)	1 (WK9)	2 (WK10)	3 (WK11)	3	3	3

Course Code		:	BAIA605E	Cloud Computing	Semester	:	6
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs.		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs.		SEE Marks	:	50
	Exam	:	06 Hrs.		Total Marks	:	100
	Total Hrs.	:	90 Hrs.		Credits	:	03

Professional Competency:

Develop the knowledge and skills to design, deploy, manage, and secure cloud computing solutions by applying cloud platforms, virtualization, containerization, resource management, and emerging cloud technologies to address real-world computing challenges efficiently and sustainably.

Course Outcomes:

After completion of the course student will be able to

CO1: Describe various cloud computing platforms and service providers.

CO2: Illustrate the significance of various types of virtualization.

CO3: Identify the architecture, delivery models and industrial platforms for cloud computing based applications.

CO4: Analyze the role of security aspects in cloud computing.

CO5: Demonstrate cloud applications in various fields using suitable cloud platforms.

UNIT-I	10 Hrs.

Distributed System Models and Enabling Technologies: Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security and Energy Efficiency.

UNIT–II	11 Hrs.

Virtual Machines and Virtualization of Clusters and Data Centers: Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.

UNIT–III	10 Hrs.

Cloud Platform Architecture over Virtualized Datacenters: Cloud Computing and Service Models, Data Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure, Inter-Cloud Resource Management.

Cloud Security: Top concern for cloud users, Risks, Privacy Impact Assessment, Cloud Data

Encryption, Security of Database Services, OS security, VM Security, Security Risks Posed by Shared Images and Management OS, XOAR, A Trusted Hypervisor, Mobile Devices and Cloud Security.

UNIT–IV **11 Hrs.**

Cloud Security and Trust Management: Cloud Security Defense Strategies, Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques, Reputation-Guided Protection of Data Centers.

Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft, Emerging Cloud Software Environments.

Text Books:

1. Kai Hwang, Geoffrey C Fox, and Jack J Dongarra, Distributed and Cloud Computing, Morgan Kaufmann, Elsevier 2012.
2. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, 2nd Edition, Elsevier. 2018.
3. Google Cloud Teaching Resources – LMS [for practical component].
4. AWS Cloud Developing – AWS Academy Courses [for practical component].

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi, Mastering Cloud Computing McGrawHill Education, 1st Edition, 2017
2. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Education, 2017.
3. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication, 1st Edition, 2009
4. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press, 2nd Edition, 2009.

Web links and Video Lectures (e-Resources):

- https://freevideolectures.com/course/4639/nptel-cloud-computing/1
- https://www.youtube.com/playlist?list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J
- https://www.youtube.com/watch?v=EN4fEbcFZ_E

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs) and WKs											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK2) (WK3) (WK4)	2 (WK2) (WK3) (WK4)	-	-	2 (WK2) (WK3) (WK6)	-	-	-	-	-	1 (WK8)	3	2	-
CO2	3 (WK3) (WK4) (WK6)	2 (WK3) (WK4) (WK6)	2 (WK5)	-	3 (WK3) (WK4) (WK6)	1 (WK1) (WK7)	-	-	-	-	1 (WK8)	3	2	-

CO3	3 (WK2) (WK3) (WK4) (WK6)	3 (WK2) (WK3) (WK4) (WK6)	3 (WK5)	2 (WK8)	3 (WK2) (WK3) (WK4) (WK6)	-	-	-	1	-	2 (WK8)	3	3	2
CO4	2 (WK4)	1 (WK4)	2 (WK5)	-	3 (WK4) (WK6)	2 (WK5) (WK7)	1 (WK9)	-	-	-	3 (WK8)	2	3	1

Course Code		:	BAIA606L	Advanced AI and ML lab	Semester	:	6
L:T:P		:	0:0:2		Course Type	:	PCC
Hours/Sem.	Teaching	:	26 Hrs.		CIE Marks	:	50
	Learning (TW+SL)	:	00 Hrs.		SEE Marks	:	50
	Exam	:	04 Hrs.		Total Marks	:	100
	Total Hrs.	:	30 Hrs.		Credits	:	01

Professional Competency:

Develop the ability to design, implement, train, optimize, evaluate, and deploy deep learning models using modern frameworks and state-of-the-art architectures for solving real-world problems in computer vision, medical image analysis, natural language processing, generative AI, and reinforcement learning.

Course Outcomes:

After completion of the course, students will be able to:

CO1: Design, implement and compare deep convolutional neural network architectures and transfer learning models for image classification and medical image analysis.

CO2: Develop and evaluate deep learning models for object detection, semantic segmentation, and image restoration using contemporary computer vision techniques.

CO3: Build and analyze generative and sequential deep learning models, including Autoencoders, GANs, LSTM with Attention, and Transformer architectures for image generation and natural language processing applications.

CO4: Develop and assess deep reinforcement learning agents and Vision Transformer-based solutions, and evaluate deep learning models using appropriate performance metrics for intelligent real-world applications.

List of Assignments:

Sl. No	Assignments
1.	**Comparative Study of CNN Architectures for Image Classification** **Objective:** Implement and compare AlexNet, VGG16, ResNet50, MobileNetV2, EfficientNetB0, and GhostNet for image classification. **Dataset:** CIFAR-10 / Intel Image Classification **Expected Outcome:** • Accuracy comparison • Training time comparison • Model size comparison • Confusion Matrix • Precision, Recall and F1-score
2.	**Medical Image Classification using Transfer Learning** **Objective:** Develop a deep learning model using transfer learning for medical image classification. **Dataset:** • Chest X-Ray Pneumonia • Brain MRI • HAM10000 **Tasks** • Fine-tune pretrained model • Compare frozen vs fine-tuned layers • Evaluate performance **Expected Outcome** Medical image classifier with deployment-ready accuracy.
3.	**Object Detection using Faster RCNN and YOLO** **Objective:** Compare Faster RCNN and YOLOv8 for real-time object detection. **Dataset** MS COCO or Pascal VOC **Tasks** • Train object detector • Detect multiple objects • Compare FPS and mAP **Expected Outcome** High-performance object detection system.
4.	**Semantic Segmentation using Mask RCNN** **Objective:** Segment objects at pixel level using Mask RCNN. **Dataset** Oxford-IIIT Pet Dataset or COCO Segmentation **Tasks** • Train segmentation model • Evaluate IoU and Dice Score • Compare with FCN **Expected Outcome** Pixel-level segmentation of multiple objects.
5.	**Image Denoising using Autoencoder** **Objective:** Build a Deep Autoencoder for image denoising.

	Dataset MNIST Fashion-MNIST **Tasks** • Add Gaussian noise • Train Denoising Autoencoder • Compare reconstructed images **Expected Outcome** Noise-free reconstructed images.

6.	**Handwritten Digit Generation using GAN** **Objective:** Develop a Generative Adversarial Network (GAN) to generate handwritten digits. **Dataset** MNIST **Tasks** • Train Generator • Train Discriminator • Visualize generated images • Compare Generator loss and Discriminator loss **Expected Outcome** Synthetic handwritten digit generation.
7.	**Sentiment Analysis using LSTM with Attention** **Objective:** Develop an LSTM-based sentiment classifier enhanced with an Attention mechanism. **Dataset** IMDb Movie Reviews **Tasks** • Text preprocessing • Word Embedding • LSTM implementation • Attention Layer • Performance comparison **Expected Outcome** Binary sentiment classification with improved accuracy.
8.	**Machine Translation using Transformers** **Objective:** Build an English-to-Kannada Neural Machine Translation system. **Dataset** OPUS Corpus or IIT Bombay English-Hindi Dataset **Tasks** • Transformer Encoder-Decoder • Tokenization • Positional Encoding • BLEU Score Evaluation **Expected Outcome** Neural Machine Translation model.
9.	**Vision Transformer (ViT) for Image Classification** **Objective:** Compare Vision Transformer with CNN architectures. **Dataset** CIFAR-100 or Flowers-102 **Tasks** • Train Vision Transformer • Compare with ResNet50 • Compare training time, accuracy and parameters **Expected Outcome**

	Performance comparison of CNN and Vision Transformer.
10.	**Deep Reinforcement Learning for Autonomous Navigation** **Objective:** Develop an autonomous navigation agent using Deep Q-Network (DQN). **Environment** OpenAI Gym (CartPole, LunarLander or MountainCar) **Tasks** • Implement Deep Q-Network • Train reinforcement learning agent • Reward optimization • Compare learning curves **Expected Outcome** An intelligent agent capable of learning optimal actions through interaction with the environment.

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CO1	3 (WK2) (WK3) (WK4)	3 (WK2) (WK3) (WK4)	3	2 (WK5)	3 (WK4) (WK5)	–	–	–	–	–	1 (WK8)	3	3	–
CO2	3 (WK3) (WK4) (WK5)	3 (WK3) (WK4) (WK5)	3	3 (WK5)	3 (WK4) (WK5)	1 (WK7)	–	–	–	–	1 (WK8)	3	3	–
CO3	3 (WK3) (WK4) WK5)	3 (WK3) (WK4) (WK5)	3	3 (WK5)	3 (WK4) (WK5)	–	–	–	1	–	2 (WK8)	3	3	3
CO4	3 (WK4) (WK5)	3 (WK4) (WK5)	3	3 (WK5)	3 (WK5) (WK6)	2 (WK7)	1 (WK9)	–	–	–	3 (WK8)	3	3	2