LNCT UNIVERSITY, BHOPAL

Programme:- BCA (AI&DA) **Semester – IV** **wef: July 2025**

Name of Paper& Category	Paper Code	Theory					
		Credit			Marks		
		L	T	J	EST	CAT	Total
Java Programming (Major)	BAI-401	3	1	0	70	30	100

Course Objective	To understand the core language features of Java and its Application Programming Interfaces (API). To build applications using the set of powerful java features. To explore and publish a useful real time application.

Units	Contents (Theory)	Hours /week
I	Introduction; Object-Oriented Paradigm; Basic Concepts of Object-Oriented Programming Benefits of OOP; Applications of OOP. Java History; Java Features; Java Support Systems, Java Environment.	8
II	Simple Java Program; Comments in java; Java Program Structure; Java Tokens; Java Statements; Implementing a Java Program; Java Virtual Machine; Command Line Arguments; Programming Style; Constants; Variables; Data Types; Variables, Constants, Standard Default Values, Operators, Expressions; Operator Precedence; Mathematical Functions.	8
III	Decision making and Branching Statements, Looping Statements, Labeled loops, Jumping Statements, Defining a Class; Adding Variables; Adding Variables; Adding Methods; Creating Objects; Accessing Class Members; Constructors; Methods Overloading; Static Members; Nesting of Methods.	8
IV	Extending a Class; Overriding Methods; Final Variables and Methods; Final Classes, Wrapper Class, Finalizer Methods; Abstract Methods and Classes; Visibility Control; Defining Interfaces; Extending Interfaces; Implementing Interfaces; Accessing Interface Variables, Basic idea of multithreading, lifecycle of a thread; Creating thread with the thread class and runnable interface, Basic idea of Exception Handling.	8
V	System Packages; Naming Conventions; Creating Packages; Accessing a Package; Using a Package; Adding a Class to a Package; Hiding Classes, Swing Life Cycle; Creating an Executable Swing, Data Connectivity (JDBC-ODBC).	8

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Text Books/Reference Books:-

Name of Authors	Titles of the Book	Edition	Name of the Publisher
E-Balagurusamy	Programming In Java	Fourth Edition	Tata McGraw Hill
Michael B. White	Mastering Java	Second Edition	BPB Publications
Ivan Bayross	Advance Java	Second Edition	BPB Publications

COURSE OUTCOMES: Students will be able to

CO1	Understand basic concepts and benefits of Object-Oriented Programming.
CO2	Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
CO3	Explore and publish a useful real time application.
CO4	Create functionality that subclasses can implement or override.
CO5	Process of how the object is created, started, stopped, and destroyed during the entire execution of its application.

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Name of Paper& Category	Paper Code	Theory					
		Credit			Marks		
Machine Learning and Pattern Recognition	**BAI-402**	**L**	**T**	**J**	**EST**	**CAT**	**Total**
		3	1	0	70	30	100

Course Objective	To introduce machine learning concepts, approaches, and evaluation methods, while enabling students to implement regression and classification models for real-world applications.

Units	Contents (Theory)	Hours /week
I	Introduction: Learning systems, real world applications of machine learning, why machine learning, variable types and terminology, function approximation Types of machine learning: Supervised learning, unsupervised learning, reinforcement learning Important concepts of machine learning: Parametric vs non-parametric models, the trade-off between prediction accuracy and model interpretability, the curse of dimensionality, measuring the quality of fit, bias-variance trade off, overfitting, model selection, no free lunch theorem.	**8**
II	Linear Regression: Linear regression, estimating the coefficients, accessing the accuracy of coefficient estimates, accessing the accuracy of the model, multiple linear regression, qualitative predictors Classification: Logistic regression, estimating regression coefficients, making predictions, multiple logistic regressions, linear discriminant analysis, bayes' theorem of classification, LDA for p=1, LDA for p>1, quadratic discriminant analysis.	**8**
III	Resampling Methods, Model Selection and Regularization: Cross-validation, leave-one-out cross- validation, k-fold cross-validation, the bootstrap, subset selection, shrinkage methods, ridge and lasso regression, dimension reduction methods, principal components regression, partial least square Tree Based Methods: Advantages and disadvantages of trees, regression Trees, classification trees, bagging, random forest, boosting.	**8**
IV	Support Vector Machine: Maximum margin classifier, classification using a separating hyperplane, the maximal margin classifier, support vector classifier, support vector machines, classification with non-linear decision boundaries, support vector machine, one-versus-one classification, one-versus- many classification.	**8**
V	**Unsupervised Learning:** Principle component analysis, what are principal components, clustering methods, k-means clustering, hierarchical clustering, Independent component analysis, latent semantic indexing, Markov Models, Hidden Markov Models.	**8**

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Text Books/Reference Books:-

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani	Introduction to Statistical Learning	2nd	Springer
Christopher M. Bishop	Pattern Recognition and Machine Learning	1st	Springer
Kevin P. Murphy	Machine Learning: A Probabilistic Perspective	1st	MIT Press
Trevor Hastie, Robert Tibshirani, Jerome Friedman	The Elements of Statistical Learning	2nd	Springer
Tom M. Mitchell	Machine Learning	1st	McGraw-Hill

COURSE OUTCOMES: Students will be able to

CO1	Understand the fundamentals of machine learning, including learning systems, applications, and basic terminology.
CO2	Explore and differentiate between supervised, unsupervised, and reinforcement learning techniques.
CO3	Analyze key machine learning concepts such as model selection, overfitting, bias-variance trade-off, and the curse of dimensionality.
CO4	Apply and evaluate linear and multiple linear regression models for predictive analysis.
CO5	Implement classification algorithms including logistic regression, linear discriminant analysis, and quadratic discriminant analysis using Bayes' theorem.

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Name of Paper& Category	Paper Code	Theory					
		Credit			Marks		
		L	T	J	EST	CAT	Total
Computer Oriented Statistical Methods (GEC)	BAI-403	3	1	0	70	30	100

Course Objective	The objective of this course is to give comprehensive knowledge about the data collection, presentation of data, pictorial representation, and measures of central tendency, measures of dispersion, control charts, correlation, regression, time series, probability, estimation and inference.

Units	Contents (*Theory*)	Hours /week
I	**Introduction to Statistics and Data Collection:** Definition of statistics, scope of statistics, limitation of Statistic, distrust of statistics. Statistical data collection- primary and secondary data, methods of collecting primary data Sources and secondary data, Census and sample investigation. Presentation of statistical data-classification, Tabulation, frequency distribution, graphic representation of a frequency distribution.	**8**
II	**Describing Business Data:** Requisites for an ideal measure of central tendency- Arithmetic- Mean, median, mode, Harmonic Mean, weighted Average, Relationship amongst different averages. Measures of Dispersion, Range, Quartile deviation, Mean Deviation, Standard Deviation-The coefficient of Variation.	**8**
III	**Sample Space, Events and Probability:** Definition of sample space, Discrete sample space, Events, Types of events, Mutually exclusive events, Exhaustive event, Simple examples, Classical definition of probability, Addition theorem of probability, conditional probability, Independence of two events.	**8**
IV	**Graphical representation:** Diagrammatic and Graphical representation of Numerical Data - Formation of frequency distribution - Histogram, Cumulative Frequency - Polygon and Ogives, Column, Pie chart, Line, Bar, Area, Scatter & Bubble Chart.	**8**
V	**Statistical Control Charts:** Statistical Control Charts- Introduction - Types of Control Charts – Setting up a Control Procedure – X bar (Mean) Chart and R Chart–c Chart–p Chart–Advantages and Limitation of Control Charts. Statistical Software like Excel, SPSS.	**8**

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Text Books/ Reference Books:-

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Trivedi K.S.	Probability and Statistics with Reliability, Queuing and computer Science applications	1994	Prentice Hall of India.
David. Levin, David. Stephen	Statistics for managers using MS-Excel	7th Edition, 2013	Pearson Education (India)
S. M. Shukla,	Business Mathematics	12th Edition, 2018	Sahitya Bhawan Publications
H. S. Sharma	Mathematical Statistics	First Edition, 2017	Ram Prasas Pub
S. P. Gupta	Business Statistics and Statistical Methods	2014	S. Chand Pub.
Andy Field	Discovering Statistics Using IBM SPSS Statistics	4th Edition, 2013	Sage Publication

COURSE OUTCOMES: Students will be able to

CO1	Organize, present and interpret statistical data, both numerically and graphically
CO2	Perform regression analysis, and compute and interpret the coefficient of correlation.
CO3	Use various methods to compute the probabilities of events.
CO4	Analyse and interpret data using appropriate statistical hypothesis and parametric testing techniques.
CO5	Construct control charts and work on tools like SPSS and Excel.

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Name of Paper& Category	Paper Code	Theory					
		Credit			Marks		
		L	T	J	EST	CAT	Total
Software Engineering (SEC)	BAI-404	3	1	0	70	30	100

Course Objective	The objective of this course is to enhance knowledge of basic SW engineering methods and practices, and their appropriate application, software designing, testing Strategies and UML models.

Units	Contents (*Theory*)	Hours /week
I	**Introduction:-** Software Product and Process Characteristics, Software Process Models: Linear Sequential Model, Prototyping Model, RAD Model, Incremental Model, Spiral Model, Rational Unified process and Agile model .	8
II	**Software Requirement Analysis:** Requirement Specifications: Need for SRS, Nature of SRS, Characteristics, Components of SRS. Requirements analysis: Feasibility Study, Information Modeling, IEEE Standards for SRS, Cost Estimation: COCOMO Model, Designing Concepts: Design Principles, Module level concepts- Cohesion and Coupling, Design notations and specifications, Verification, Metrics.	8
III	**Object Oriented Design:** Concepts, Design Notation and Specification, Design methodology, metrics. Debugging Process: Information Gathering, Fault Isolation, Fault Confirmation, Documentation, Fixing fault isolation.	8
IV	**Testing:** Testing Fundamental, Functional Testing (Black Box), Structural Testing (White Box), Alpha and Beta Testing, Testing Object Oriented Programs, Testing Process: Comparison of Different Testing, Level of Testing. Project management for special classes of software projects: Using CASE tools, CBSE.	8
V	**UML:** An overview of UML- UML notations, UML Class diagrams- association, multiplicity, generalization, aggregation, interfaces.	8

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Text Books/Reference Books:-

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Ian Sommerville	Software Engineering	9th Edition	Pearson Education Ltd, 2010
Roger S. Pressman	Software Engineering, A Practitioner's approach	7th Edition	Mc GRAW- HILL Publication, 2010
Pankaj Jalote	An integrated approach to Software Engineering	3rd Edition	Narosa Publishing House, 2013

COURSE OUTCOMES: Students will be able to

CO1	Understand software development life cycles.
CO2	Understand elicitation process and SRS.
CO3	Apply object oriented designing to an application.
CO4	Understand testing Strategic.
CO5	Prepare UML diagrams.

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Name of Paper & Category	Paper Code	Theory					
		Credit			Marks		
		L	T	J	EST	CAT	Total
AI Product Development and Deployment (GEC)	BAI-405	3	1	0	70	30	100

Course Objective	To understand AI product goals and feasibility, while building prototypes, developing fair and unbiased models, and deploying scalable AI systems with modern tools and frameworks

Units	Contents (*Theory*)	Hours /week
I	**AI Product Prototyping: Strategy, Experimentation, and Responsible Design :**Problem Definition & Stakeholder Alignment: Define Stakeholders, Business and Technical Requirement, Feasibility Analysis, KPIs, Data Strategy & Prototyping: What is Prototype, Rapid-Prototype Workflow, Jupyter Notebook, Sreamlit, Gradio, Generate Synthetic Data with Faker, Greetal.ai	**8**
II	**Model Prototyping & Experimentation:** Protype Models, Multiple Model, Baseline Model, Moving to Advanced Model, Track Experiments, MLFlow, Ethics & Bias in Prototyping: Bias in AI, How Bias Sneaks, Spotting Bias Early, Fairlearn, Aequitas, Key Fairness Metrics	**8**
III	**Production-Ready AI Optimization, Packaging, and Reproducibility :** Model Optimization: Hyperparameter Tuning, Model Pruning, Quantization, Knowledge Distillation, TinyML Optimization, ONNX for Portability, Quantization-Aware Training (QAT), Model Packaging: Package Models, Packaging Formats, MLflow Models, MLflow Packaging Docker, Docker Packaging, PMML, PMML Packaging, pip requirements, conda environemnt, Reproducibility & Versioning: Tools, Git, DVC Commands, Combining Git and DVC, Versioning Models, Versioning Environment	**8**
IV	**Scalable AI Deployment: Architectures, Containers & Edge Systems :** Deployment Architecture: What is Deployment, Deployment Methods, REST API, FastAPI, Batch Processing, Tools for Batch Jobs, Serverless, AWS Lambda, Model Serving Frameworks, Containerization & Orchestration: What is Container, Packaging vs Containerization, Dockerfile, Docker Compose, Orchestration, What is Kubernetes(K8), Pod in Kubernetes, Kubernetes Cluster Components, Master Node, Worker Node, Kubelet, Deployment YAML. Replicas, Cloud vs Edge Deployment: Why Reproducibility Matters, Cloud Deployment vs Edge Deployment, When to use, AWS SageMaker, Google Vertex AI, ONNX runtime, Hybrid Deployment	**8**
V	**AI in Production: Monitoring, CI/CD, and Business Integration :** Monitoring & Observability: What is Monitoring, Monitoring vs. Logging vs. Observability, Logs, Metrics, and Alerts, Open-Source Tools for Monitoring ML, Prometheus, Grafana,	**8**

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	Evidently AI, CI/CD for AI Systems: What is CI/CD, Key Components, Automated Retraining, Data Drift & Triggering Retrain, Apache Airflow, Kuberflow, Business Integration & ROI in AI: What is AI ROI, What AI Project Fail, Successful AI Project, Measuring ROI with KPI.	

Text Books/ Reference Books:-

Name of Authors	Titles of the Book	Edition	Name of the Publisher
Chip Huyen	Designing Machine Learning Systems	1st	O'Reilly Media
Andriy Burkov	Machine Learning Engineering	1st	True Positive Inc.
Mark Treveil, Alok Shukla	Introducing MLOps	1st	O'Reilly Media
Emmanuel Ameisen	Building Machine Learning Powered Applications	1st	O'Reilly Media
Jeff Smith	Machine Learning Systems: Designs that Scale	1st	Manning Publications

COURSE OUTCOMES: Students will be able to

CO1	Define AI project goals through stakeholder alignment, feasibility analysis, and KPI-driven problem scoping.
CO2	Build rapid AI prototypes using tools like Jupyter, Streamlit, and Gradio, along with synthetic data generation.
CO3	Experiment with baseline and advanced models, track experiments, and integrate ethical considerations using fairness toolkits.
CO4	Optimize, package, and version AI models using techniques like quantization, pruning, Docker, MLflow, Git, and DVC.
CO5	Deploy scalable AI solutions across cloud and edge systems and integrate monitoring, CI/CD pipelines, and ROI evaluation for production readiness.

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Name of Paper& Category	Paper Code	Practical				
		Credit		Marks		
		P	J	ESP	CAP	Total
Programming Lab in JAVA (Major)	BAI-406	2	-	70	30	100

Contents (Practical) :-

1. To demonstrate the usage of Math class.
2. To implement the methods of String class.
3. Implementation of interfaces.
4. Implementation of inheritance.
5. Implementation of super and this.
6. Implementation of static variables and methods.
7. Implementation of Exceptions.
8. To implement multithreading by extending Thread class.
9. To demonstrate File Input Stream and File Output Stream Classes.
10. To demonstrate the creation of applets and passing parameters to applets.

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Name of Paper & Category	Paper Code	Practical				
		Credit		Marks		
		P	J	ESP	CAP	Total
Programming Lab in Machine Learning (Minor)	BAI-407	2	-	70	30	100

Contents (Practical):-

1. Prediction using simple linear regression
2. Prediction using multiple linear regression
3. Classification using Logistics regression
4. Classification using linear discriminant analysis
5. Classification using support vector machine
6. Classification using Guassian Naïve Bayes
7. Classification using decision Tree
8. Classification using Random Forest
9. Classification using K nearest neighbour