Kurukshetra University, Kurukshetra

(Established by the State Legislature Act XII of 1956)

('A++' Grade, NAAC Accredited)

|| योगस्थ: कुरु कर्माणि ||

समबुद्धि व योग युक्त होकर कर्म करो

(Perform Actions while Stead fasting in the State of Yoga)

Scheme of Examination (5th and 6th Semester) for Under-Graduate Programmes

Bachelor of Computer Applications (BCA) (ARTIFICIAL INTELLIGENCE) : SCHEME D

according to

Curriculum Framework for Under-Graduate Programmes

As per NEP-2020 (Multiple Entry-Exit, Internships and Choice Based Credit System)

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS

(For the Batches Admitted From 2023-2024)

Kurukshetra University Kurukshetra
Scheme of Examination (5th and 6th Semester) for Undergraduate programmes
Subject: BCA (Artificial Intelligence)
According to
Curriculum Framework for Undergraduate Programmes
as per NEP 2020 (Multiple Entry-Exit, Internships, and Choice Based Credit System)

Sem	Course Type	Course Code	Nomenclature of paper	Credits	Contact hours	Internal marks	End term Marks	Total Marks	Duration of exam (Hrs) T + P
5	CC-A5	B23-CAL-501	Machine Learning Fundamentals	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-B5	B23-CAL-502	Python Programming for Machine Learning	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-C5	B23-CAL-503	Computer Graphics	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-M5(V)	To be taken from VOC Pool							
	SEC-4	Internship @ 4 Credits							
6	CC-A6	B23-CAL-601	Introduction to Neural Networks	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-B6	B23-CAL-602	Python Programming for Deep Learning	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-C6	B23-CAL-603	Data Mining and Warehousing	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-M6	B23-CAL-604	Design Thinking and Product Innovation	3	3	20	50	70	3

			Practical	1	2	10	20	30	3
	CC-M7(V)	To be taken from VOC Pool							

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समबुद्धि व योग युक्त होकर कर्म करो
(Perform Actions while Stead fasting in the State of Yoga)

Syllabus of Examination (5th & 6th Semester) for Under-Graduate Programmes
Bachelor of Computer Applications (BCA) (Artificial Intelligence)
Scheme D
according to
Curriculum Framework for Under-Graduate Programmes
As per NEP-2020 (Multiple Entry-Exit, Internships and Choice Based Credit System)
DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
(For the Batches Admitted From 2023-2024)

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

<table>
<tr><th colspan="4">Scheme: 2023-24, Syllabus: 2025-26</th></tr>
<tr><th colspan="4">Part A - Introduction</th></tr>
<tr><td>Subject</td><td colspan="3">BCA(Artificial Intelligence)</td></tr>
<tr><td>Semester</td><td colspan="3">V</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Machine Learning Fundamentals</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CAL-501</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="3">CC-A5</td></tr>
<tr><td>Level of the course (As perAnnexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">Knowledge of Basic AI</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Understand the key concepts, types, and workflow of machine learning.
2. Implement supervised and unsupervised learning algorithms using Python.
3. Apply model evaluation techniques to assess performance.
4. Solve real-world classification and clustering problems using machine learning.
5*. Implement the various machine learning models.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td colspan="2">Max. Marks:100(70(T)+30(P))
Internal Assessment Marks:30(20(T)+10(P))
End Term Exam Marks: 70(50(T)+20(P))</td><td colspan="2">Time: 3 Hrs.(T), 3Hrs.(P)</td></tr>
<tr><th colspan="4">Part B- Contents of the Course</th></tr>
<tr><td colspan="4"><u>Instructions for Paper-Setter</u>
The examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus.
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<tr><th>Unit</th><th colspan="2">Topics</th><th>Contact Hours</th></tr>
<tr><td>I</td><td colspan="2">Introduction to Machine Learning:
Definition and scope of machine learning, types of machine learning – supervised, unsupervised, reinforcement learning, real-world</td><td>11</td></tr>
</table>

	applications of machine learning, machine learning pipeline, features and labels, training and testing datasets, model building and evaluation process	
II	**Supervised Learning Algorithms:** Linear regression, logistic regression, decision trees, k-nearest neighbors (k-NN), support vector machines (SVM), naïve Bayes classifier, model evaluation metrics – confusion matrix, accuracy, precision, recall, F1-score, cross-validation	11
III	**Unsupervised Learning Algorithms:** Clustering – k-means, hierarchical clustering, DBSCAN, dimensionality reduction using PCA, evaluation of clustering results, association rule mining – support, confidence, lift, Apriori algorithm, market basket analysis	11
IV	**Model Optimization and Real-World Applications:** Data preprocessing – normalization, standardization, encoding categorical variables, overfitting and underfitting, regularization – L1 and L2, feature selection techniques, ensemble methods – bagging, boosting, random forest, real-world use cases – spam detection, credit scoring, customer segmentation	12
V*	Practicum: Students are advised to do laboratory/practical practice not limitedto but including the following types of problems: • Implement linear regression on a dataset and evaluate model performance • Apply logistic regression to binary classification problems • Use k-NN and Decision Trees for classification tasks • Build and evaluate clustering models using k-means and hierarchical clustering • Perform data preprocessing techniques including encoding and scaling • Apply PCA for dimensionality reduction and visualize clusters • Conduct market basket analysis using Apriori algorithm • Train and evaluate ensemble models such as Random Forest and AdaBoost	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA		**End-Term Examination:**A three-hour exam for boththeory and practicum. **End Term Exam Marks: 70(50(T)+20(P))**
Part C-Learning Resources		

Recommended Books/e-resources/LMS:

- Tom M. Mitchell – *Machine Learning*
- Aurélien Géron – *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*
- Ethem Alpaydin – *Introduction to Machine Learning*
- Peter Flach – *Machine Learning: The Art and Science of Algorithms That Make Sense of Data*
- Sebastian Raschka and Vahid Mirjalili – *Python Machine Learning*
- Andreas C. Müller and Sarah Guido – *Introduction to Machine Learning with Python*

*Applicable for courses having practical components.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY, KURUKSHETRA

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<tr><td>Subject</td><td colspan="3">BCA (Artificial Intelligence)</td></tr>
<tr><td>Semester</td><td colspan="3">V</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Python Programming for Machine Learning</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CAL-502</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="3">CC-B5</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">Knowledge of basics of Python.</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Perform numerical operations using NumPy essential for deep learning computations.
2. Manipulate and preprocess structured data using Pandas for training deep learning models.
3. Visualize data and model metrics using Matplotlib and Plotly.
4. Apply machine learning techniques using scikit-learn to prepare for deep learning workflows.
5*. Implement the various tools and techniques used in machine learning.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td colspan="2">Max. Marks:100(70(T)+30(P))
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End Term Exam Marks: 70(50(T)+20(P))</td><td colspan="2">Time: 3 Hrs.(T), 3Hrs.(P)</td></tr>
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<tr><td colspan="4"><u>Instructions for Paper-Setter</u>
The examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus.
Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory.
The practicum will be evaluated by an external and an internal examiner. The examination will be of</td></tr>
</table>

three-hour duration.

Unit	Topics	Contact Hours
I	**NumPy** Introduction to NumPy, array creation, indexing and slicing, reshaping arrays, broadcasting, mathematical operations on arrays, statistical operations, random number generation, linear algebra using NumPy	11
II	**Pandas** Introduction to Pandas, Series and DataFrames, reading and writing data from CSV and Excel, filtering and selection, handling missing values, grouping and aggregation, merging and joining datasets, feature extraction, time-series analysis	11
III	**Matplotlib and Plotly** Basics of data visualization, line plots, bar plots, scatter plots, histograms, pie charts, customizing plots (title, labels, colors, legends), subplots, introduction to Plotly, interactive plots, 3D visualizations, dynamic plots for model metrics	11
IV	**scikit-learn** Introduction to machine learning, supervised vs unsupervised learning, data preprocessing (scaling, encoding, splitting), building models using Linear Regression, Decision Tree, k-Nearest Neighbors, Support Vector Machines, model evaluation using accuracy, confusion matrix, precision, recall	12
V*	Practicum: Students are advised to do laboratory/practical practice not limitedto but including the following types of problems: • **NumPy**: Create and reshape arrays, perform element-wise and matrix operations, simulate random data, apply statistical functions • **Pandas**: Load datasets, clean missing values, filter rows and columns, merge datasets, perform group-by and aggregation • **Matplotlib and Plotly**: Plot charts for data distribution, customize visualizations, build interactive charts, visualize training performance over epochs • **scikit-learn**: Preprocess data, train machine learning models, evaluate model performance, implement basic classification and regression problems	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End-Term Examination:**A three-hour exam for boththeory and practicum. **End Term Exam Marks: 70(50(T)+20(P))**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Wes McKinney – *Python for Data Analysis*
- Jake VanderPlas – *Python Data Science Handbook*
- Aurélien Géron – *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*
- Joel Grus – *Data Science from Scratch*
- Mark Summerfield – *Programming in Python 3*
- François Chollet – *Deep Learning with Python*

*Applicable for courses having practical components.

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<tr><td>Subject</td><td colspan="3">BCA (Artificial Intelligence)</td></tr>
<tr><td>Semester</td><td colspan="3">V</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Computer Graphics</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CAL-503</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="3">CC-C5</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">Basic Knowledge of computer</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. understand the concepts of computer graphics
2. learn and implement point, line, and circle drawing algorithms.
3. acquire knowledge of two-dimensional transformations and line clipping algorithms.
4. understand 3-D graphics concepts and acquire skills for designing 3-D graphics
5*. to design programs based on theoretical concepts of Computer Graphics.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
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<tr><td colspan="4"><u>Instructions for Paper-Setter</u>
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The candidate must attempt five questions in all, selecting one question from each unit. First question will be compulsory.
Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.</td></tr>
</table>

Part B- Contents of the Course		
Unit	**Topics**	**Contact Hours**
I	**Introduction**: History of Computer Graphics (CG), Applications of Computer Graphics, Components of interactive graphics systems **Display devices**: Refresh CRT, Color CRT, Plasma Panel displays LCD Panels, Raster-scan System, Random scan System, Graphic software, Input/Output Devices, Tablets	11
II	**Output Primitives**: Points and Lines, Line Drawing Algorithms: DDA algorithm, Bresenham's algorithm, **Circle drawing Algorithms**: Polynomial Method, Bresenham's algorithm. Parametric representation of Cubic Curves, Bezier Curves	11
III	**2D Transformation**: Use of Homogeneous Coordinates Systems, Composite Transformation: Translation, Scaling, Rotation, Mirror Reflection, Rotation about an Arbitrary Point. Clipping and Windowing, Clipping Operations. **Line Clipping Algorithms**: The Mid-Point subdivision method, Cohen-Sutherland Line Clipping Algorithms, Polygon Clipping, Sutherland Hodgeman Algorithms, Text Clipping.	12
IV	**3-D Graphics**: 3-D object representations, 3-D Transformations: Translation, Rotation, Scaling, Projections, **Hidden surface elimination**: Back face removal, Depth Buffer algorithm, Scan-line algorithm, Depth sort algorithm, Shading.	11
V*	The following activities be carried out/ discussed in the labduring the semester. Programming Lab: • Implement DDA line drawing algorithm for all types of slope. • Implement Bresenham's line drawing algorithm for all types of slopes. • Implement Bresenham's Circle drawing algorithm. • Implement Bresenham's Ellipse drawing algorithm. • Implement various 2-D transformations on objects like lines, rectangles, etc. • Implement to clip a line using the Mid-Point subdivision algorithm • Implement to clip a line using Cohen-Sutherland algorithm • Implement 3-D transformations on objects.	30
Suggested Evaluation Methods		
Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA		**End Term Examination: A three-hour exam for both theory and practicum. End Term Exam Marks:**

	70(50(T)+20(P))

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Donald Hearn, M. Pauline Baker, Computer Graphics, Pearson Education.
- J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes, Computer Graphics - Principles and Practice, Pearson Education.
- Newmann & Sproull, Principles of Interactive Computer Graphics, McGraw Hill.
- Rogers, David F., Procedural Elements of Computer Graphics, McGraw Hill.
- Zhigang Xiang, Roy Plastock, Computer Graphics, Tata McGraw Hill.

*Applicable for courses having practical components.

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<tr><td>Subject</td><td colspan="3">BCA (Artificial Intelligence)</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Introduction to Neural Networks</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CAL-601</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="3">CC-A6</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">Basics of Machine Learning</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Understand the fundamentals of artificial neural networks and their biological inspiration
2. Explain perceptron learning and activation functions used in neural networks
3. Apply training techniques like forward and backward propagation in multilayer networks
4. Implement and analyze neural network models using real-world datasets
5. * Practicals based on Machine Learning</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
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The candidate must attempt five questions, selecting one from each unit. The first question will be compulsory.
The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.

Unit	Topics	Contact Hours
I	**Introduction to Neural Networks:** Biological neuron vs artificial neuron, neural network structure, types of neural networks – feedforward, recurrent, convolutional, single-layer perceptron, limitations of perceptron, applications of neural networks in real-world scenarios	11
II	**Activation and Loss Functions, Perceptron Learning:** Step function, sigmoid, tanh, ReLU, softmax, mean squared error, cross-entropy loss, learning rate, weight initialization, perceptron learning algorithm, logic gates using perceptron, linear vs non-linear separability	11
III	**Multilayer Neural Networks and Backpropagation:** Structure of multilayer perceptrons, forward propagation, backward propagation algorithm, gradient descent, stochastic and mini-batch gradient descent, overfitting and regularization, dropout and batch normalization	11
IV	**Applications and Trends in Neural Networks:** Image classification, speech recognition, natural language processing basics, introduction to convolutional neural networks (CNN), introduction to recurrent neural networks (RNN), transfer learning, trends in deep learning and neural network research	12
V*	The following activities be carried out/ discussed in the lab during the initial period of the semester. Programming Lab: • Simulate a single-layer perceptron for AND, OR, XOR gates • Visualize and apply different activation functions • Implement forward and backward propagation manually using NumPy • Train a multilayer perceptron for image classification using Keras • Plot accuracy and loss over epochs • Demonstrate overfitting and use dropout for regularization • Use a pretrained neural network for classification using transfer learning • Analyze neural network performance using confusion matrix and accuracy metrics	30
Suggested Evaluation Methods		

Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.:5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.:10 • Mid-Term Exam: NA	**End Term Examination:** **A three-hour exam for both theory and practicum.**
Part C-Learning Resources	
Recommended Books/e-resources/LMS: • Simon Haykin – *Neural Networks and Learning Machines* • Michael Nielsen – *Neural Networks and Deep Learning* • François Chollet – *Deep Learning with Python* • Aurélien Géron – *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* • Charu C. Aggarwal – *Neural Networks and Deep Learning: A Textbook* • Satish Kumar – *Neural Networks: A Classroom Approach*	

*Applicable for courses having practical component.

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<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Python Programming for Deep Learning</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CAL-602</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="3">CC-C5</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">Basic Knowledge of Python Programming</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Build and train deep learning models using Tensor-Flow for real-world applications
2. Develop neural networks using Keras and tune hy-perparameters
3. Apply OpenCV for preprocessing and visualizing image data in deep learning workflows
4. Integrate Python tools to automate and visualize deep learning pipelines
5. * Implement Practicals based on Deep Learning</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
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<tr><th>Unit</th><th colspan="2">Topics</th><th>Contact Hours</th></tr>
<tr><td>I</td><td colspan="2">TensorFlow:
Introduction to TensorFlow, computational graphs, tensors and tensor operations, constants and variables, gradient computation using GradientTape, building simple neural networks using low-level</td><td>11</td></tr>
</table>

	TensorFlow, TensorBoard for visualizing training, saving and restoring models	
II	**Keras:** Keras architecture and workflow, sequential and functional APIs, defining dense and dropout layers, compiling models with optimizers and loss functions, training and validating models, evaluation metrics, callbacks – early stopping, model checkpointing, model serialization and loading	11
III	**OpenCV for Deep Learning:** Introduction to OpenCV, loading and displaying images, resizing and cropping, color space conversion, filtering and blurring, edge detection, contour detection, image thresholding, preprocessing image data for CNNs, drawing and annotating images, integrating OpenCV with deep learning pipelines	12
IV	**Integration and Applications:** Image classification using CNNs, sentiment analysis using text data, object detection using pretrained models, real-time image recognition using webcam feed, transfer learning – VGG16, MobileNet, ResNet, automation of data pipelines using Python, deployment basics of deep learning models	11
V*	**Practicum**: • Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Build and train a basic neural network using TensorFlow • Visualize training progress using TensorBoard • Construct and tune deep learning models using Keras (with dropout, callbacks) • Train a CNN on MNIST or CIFAR-10 using Keras • Use OpenCV to read, preprocess, and transform image data • Detect and annotate image features using OpenCV filters and contours • Perform transfer learning with pretrained networks like VGG16 or MobileNet • Integrate real-time webcam feed with a trained image classifier	30

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End-Term Examination:** A three-hour exam for both theory and practicum. **End Term Exam Marks: 70(50(T)+20(P))**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- François Chollet – *Deep Learning with Python*
- Aurélien Géron – *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*
- Adrian Rosebrock – *Deep Learning for Computer Vision with Python*
- Ian Goodfellow, Yoshua Bengio and Aaron Courville – *Deep Learning*
- Michael Nielsen – *Neural Networks and Deep Learning*
- Sebastian Raschka and Vahid Mirjalili – *Python Machine Learning*

* Applicable for courses having practical components.

DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
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<table>
<tr><th colspan="4">Scheme: 2023-24, Syllabus: 2025-26</th></tr>
<tr><th colspan="4">Part A - Introduction</th></tr>
<tr><td>Subject</td><td colspan="3">BCA (Artificial Intelligence)</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Data Mining and Warehousing</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CAL-603</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="3">CC-C6</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">Basics of Databases, Python Programming, Probability & Statistics, Introduction to AI</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Understand the architecture and components of data warehousing and data mining systems.
2. Apply preprocessing and transformation techniques to prepare data for mining.
3. Use classification, clustering, and association algorithms to discover patterns.
4. Design and query data warehouses using OLAP operations.
5. *Implement data mining techniques using Python and visualization libraries.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td colspan="2">Max. Marks:100(70(T)+30(P))
Internal Assessment Marks:30(20(T)+10(P))
End Term Exam Marks: 70(50(T)+20(P))</td><td colspan="2">Time: 3 Hrs.(T), 3Hrs.(P)</td></tr>
<tr><td colspan="4"><u>Instructions for Paper-Setter</u>
The examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. The examination will be of three-hour duration. All questions will carry equal marks. The first question will comprise short answer-type questions covering the entire syllabus.
The candidate must attempt five questions in all, selecting one question from each unit. The first question will be compulsory.
The practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.</td></tr>
</table>

Part B- Contents of the Course		
Unit	**Topics**	**Contact Hours**
I	**Introduction to Data Warehousing and Data Preprocessing:** Introduction to data warehousing – characteristics, benefits, and architecture, Data Marts, ETL process, OLAP vs OLTP, OLAP operations – roll-up, drill-down, slice, dice, pivot, Data cube and dimensional modeling – star and snowflake schemas, Data preprocessing – cleaning, integration, transformation, reduction, normalization techniques.	11
II	**Introduction to Data Mining and Association Analysis**: Introduction to data mining – goals, functions, KDD process, Types of data – structured, unstructured, Data mining architecture, Frequent pattern mining – Apriori algorithm, FP-Growth algorithm, Evaluation of association rules – support, confidence, lift, Applications – market basket analysis, recommendation engines.	11
III	**Classification and Prediction Techniques**: Classification vs prediction, Decision tree classifiers (ID3, C4.5), Naïve Bayes classification, K-nearest neighbor, Rule-based classification, Model evaluation – confusion matrix, accuracy, precision, recall, F1-score, ROC curve, Cross-validation, Overfitting and pruning.	11
IV	**Clustering, Trends and Applications in AI**: Clustering – introduction and applications, Partitioning methods – K-means, K-medoids, Hierarchical clustering – agglomerative and divisive, Cluster evaluation methods – silhouette score, DB index, Applications of data mining in AI – fraud detection, healthcare, customer segmentation, Web mining, text mining, privacy and ethical issues in data mining.	12
V*	The following activities be carried out/ discussed in the lab during the semester. Programming Lab: • Creating and querying a star schema and snowflake schema using SQL • Performing data preprocessing – cleaning, normalization, transformation using Python • Implementing Apriori algorithm using Python or ML libraries • Implementing FP-Growth for frequent itemset generation • Building and evaluating a decision tree classifier using Scikit-learn • Applying Naïve Bayes for classification problems • Performing K-means clustering on sample datasets • Visualizing clusters using Matplotlib/Seaborn • Performing OLAP operations using Python-based tools or SQL queries • Mini Project: Applying a complete data mining pipeline (pre-processing, mining, visualization) to a real dataset	30
Suggested Evaluation Methods		

Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination: A three-hour exam for both theory and practicum. End Term Exam Marks: 70(50(T)+20(P))**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Jiawei Han, Micheline Kamber and Jian Pei – *Data Mining: Concepts and Techniques*, Morgan Kaufmann
- Margaret H. Dunham – *Data Mining: Introductory and Advanced Topics*, Pearson
- Alex Berson and Stephen J. Smith – *Data Warehousing, Data Mining & OLAP*, McGraw-Hill
- Arun K. Pujari – *Data Mining Techniques*, Universities Press
- Pang-Ning Tan, Michael Steinbach and Vipin Kumar – *Introduction to Data Mining*, Pearson
- Ian Witten, Eibe Frank, Mark A. Hall – *Data Mining: Practical Machine Learning Tools and Techniques*, Morgan Kaufmann.

*Applicable for courses having practical components.

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<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Design Thinking and Product Innovation</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CAL-604</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="3">CC-M6</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="3">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="3">Basic understanding of software development and AI applications</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Understand and apply the five stages of design thinking in AI problem-solving.
2. Identify real-world problems and define user-centric product goals.
3. Create and test prototypes for AI-based products using iterative feedback.
4. Apply innovation frameworks to bring AI product ideas to market.
5. *Implement Practical aspects of innovations.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
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<tr><td colspan="4"><u>Instructions for Paper- Setter</u>
Examiner will set a total of nine questions. Out of which first question will be compulsory. Remaining eight questions will be set from four unit selecting two questions from each unit. Examination will be of three-hour duration. All questions will carry equal marks. First question will comprise of short answer type questions covering entire syllabus.
Candidate will have to attempt five questions in all, selecting one question from each unit. First question will be compulsory.</td></tr>
</table>

Practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.		
Unit	**Topics**	**Contact Hours**
I	**Foundations of Design Thinking**: Definition and significance of design thinking, Human-centered design principles, Five phases of design thinking – empathize, define, ideate, prototype, test, Need for design thinking in AI product development, Overview of product innovation, Introduction to innovation frameworks – Lean Startup, Agile, MVP	11
II	**Empathy, Problem Definition and Ideation**: Empathy research – interviews, surveys, observation techniques, Persona development, User journey maps, Defining meaningful problem statements – "How Might We" framework, Brainstorming techniques – SCAMPER, reverse thinking, Affinity mapping and idea clustering, Mapping AI capabilities to user problems	11
III	**Prototyping and Testing for AI Products**: Types of prototypes – low-fidelity, high-fidelity, Wireframing tools (Figma, Balsamiq), Storyboarding and user flows, User testing – methods and metrics, Feedback loops and iterations, Aligning AI model outputs with UX goals, Examples of AI-powered product mock-ups (e.g., chatbot UI, recommendation UI)	11
IV	**Innovation and Real-World AI Product Development**: AI product lifecycle – from concept to deployment, Go-to-market strategy, Risk assessment and feasibility study, Innovation in AI domains – healthcare, education, fintech, social good, Introduction to AI ethics – fairness, transparency, bias, Case studies – successful AI product innovation journeys (e.g., Siri, Google Lens, ChatGPT)	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Conduct empathy interviews and create personas for an AI product idea • Create a user journey map for an AI-driven solution • Define problem statements using the "How Might We" method • Brainstorm AI solution features and cluster ideas using affinity mapping • Develop low-fidelity wireframes using pen-and-paper or Figma • Build a clickable prototype/mock UI for an AI-based product • Collect user feedback through usability testing • Present product idea using elevator pitch and lean canvas • Map AI model input-output flow with UX design • Mini project: End-to-end product concept (empathy to proto-	30

	type) of an AI-based application (e.g., AI tutor, sentiment analyzer)	

Suggested Evaluation Methods

Internal Assessment: ➢ **Theory** • Class Participation: 5 • Seminar/presentation/assignment/quiz/class test etc.: 5 • Mid-Term Exam: 10 ➢ **Practicum** • Class Participation: NA • Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**End Term Examination:** A three-hour exam for both theory and practicum.

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Tim Brown – *Change by Design*, Harvard Business Press
- Jeanne Liedtka and Tim Ogilvie – *Designing for Growth: A Design Thinking Toolkit for Managers*, Columbia Business School Publishing
- Jake Knapp – *Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days*, Simon & Schuster
- Tom Kelley and David Kelley – *Creative Confidence*, Crown Business
- Vijay Kumar – *101 Design Methods: A Structured Approach for Driving Innovation*, Wiley
- Barry O'Reilly – *Lean Enterprise: How High Performance Organizations Innovate at Scale*, O'Reilly Media.

*Applicable for courses having practical components.