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)

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

Bachelor of Computer Applications (BCA) (DATA SCIENCE) : 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
Modified Scheme of Examination (5th and 6th Semester) for Undergraduate programmes
Subject: BCA (Data Science)
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-CDS-501	Machine Learning Fundamentals using Python	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-B5	B23-CDS-502	Cloud Computing for Data Science	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-C5	B23-CDS-503	Computer Networks	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-CDS-601	Data Visualization	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-B6	B23-CDS-602	Internet of Things	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-C6	B23-CDS-603	Basics of Neural Networks and Deep Learning	3	3	20	50	70	3
			Practical	1	2	10	20	30	3
	CC-M6	B23-CDS-604	Design and Innovation Thinking	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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॥ योगस्थ: कुरु कर्माणि ॥
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) (Data Science)
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(Data Science)</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 using Python</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CDS-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 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 Basic Python</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. learn the basic of Numpy and Pandas.
2. understand about basics of machine learning.
3. Know about supervised learning.
4. Know about unsupervised learning
5*. Implement the various machine learning models in python.</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.
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	**Python Libraries for Data Handling and Manipulation**: Introduction to NumPy for numerical computing with Python, Working with arrays and matrices in NumPy, Introduction to Pandas for data manipulation and analysis, Data structures in Pandas: Series, DataFrame, Index, Data cleaning and preprocessing techniques using Pandas	11
II	**Introduction to Machine Learning:** **Introduction:** Definition, History and Application of Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Semi Supervised, and Reinforcement Learning. Labeled and Unlabeled Dataset. Supervised Learning Tasks: Regression vs. Classification, Learning Framework: Training, Validation and Testing of ML models. Performance Evaluation Parameters: Confusion matrix, Accuracy, Precision, Recall, F1 Score,and AUC.	11
III	**Supervised Learning:** **Regression:** Linear and non-linear Regression, Logistic Regression. **Classification:** Naïve Bayes, K Nearest Neighbors, Decision Trees.	12
IV	**Unsupervised Learning:** **Clustering:** K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. **Dimensionality Reduction:** PCA **Applications:** Customer Segmentation, Anomaly Detection	11
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Load a dataset (e.g., Iris dataset, Titanic dataset) into Python using Pandas. Explore the dataset by: (i) Displaying the first few rows. (ii) Checking for missing values. (iii) Calculating summary statistics. (iv) Visualizing distributions of numerical variables. (v) Perform data preprocessing tasks. • Implement linear regression on a dataset and visualize the regression line. • Implement logistic regression on a binary classification data set and plot the decision boundary. • Implement and evaluate the performance of Decision tree ID3/ Cart classifier for any given dataset. • Implement and evaluate the performance of the Naïve Bayes Classifier on a given dataset. • Implement K-Means clustering on a point dataset and visualize and evaluate the clusters. • Implement hierarchical clustering on a dataset. • Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters. • Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction.	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:

- "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
- "Introduction to Machine Learning" by Ethem Alpaydin
- "Introduction to Machine Learning with Python: A Guide for Data Scientists" by Andreas C. Müller and Sarah Guido
- "Python for Data Analysis" by Wes McKinney
- Oliver Theobald, Machine Learning for absolute beginners.
- Jiawei Han and MichelineKamber, Data Mining Concepts and Techniques
- C.M. Bishop, Pattern Recognition and 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 (Data Science)</td></tr>
<tr><td>Semester</td><td colspan="3">V</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Cloud Computing for Data Science</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CDS-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">None</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Use Cloud-Based software services by comprehending the cloud Computing Architecture.
2. Configure Virtual Machines using Virtualization techniques.
3. Implement Virtualized storage system in Cloud.
4. Use Machine Learning algorithms in Cloud Environment
_____
5*. to equip with the knowledge of cloud technology introductory programming.</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:75(50(T)+25(P))
Internal Assessment Marks:20(15(T)+5(P))
End Term Exam Marks: 55(35(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. The remaining eight questions will be set from four units 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, selecting one from each unit. The first question will be compulsory.</td></tr>
</table>

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 Cloud Computing**: **Introduction to Cloud Computing:** Definition, Evolution of Cloud computing (from Mainframes to Clouds), Service – Oriented Architecture, Web Services, Grid Computing, Utility Computing, Characteristics of a Cloud computing. **Cloud computing architecture:** Basic components: front-end platform, back-end, platform, Networking, cloud based delivery. **Cloud Service Models:** Software as a Service (SaaS), Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Continuous delivery using PaaS	11
II	**Virtualization and Cloud Computing**: Introduction to Virtualization, types of Virtualization, Application Virtualization, Network Virtualization, Desktop Virtualization, Storage Virtualization, Server Virtualization, Data virtualization **Cloud Deployment Models:** Public, Private, Community, Hybrid, Role of Cloud computing in data Science, Advantages of Cloud Computing in Machine Learning	11
III	**Cloud Storage**: **Cloud Storage:** Introduction, Benefits of using Cloud Storage, Use cases of Cloud Storage (Backup, Archiving, Disaster recovery, Data processing, Content delivery) **Cloud storage system:** Block-Based, File-Based, Object-Based Storages	11
IV	**Cloud Computing for Data Science**: **Machine Learning in the Cloud:** Benefits and Limitations. **Types of Cloud-Based Machine Learning Services:** Artificial Intelligence as a Service (AIaaS), GPU as a Service (GPUaaS), Introduction to various ML systems and benefits of using Managed ML platforms. **Cloud Machine Learning Platforms:** AWS SageMaker, Azure Machine Learning studio, Google Cloud AutoML	12
V*	The following activities be carried out/ discussed in the lab during the initial period of the semester. Programming Lab: • Use Google Services to create Doc/Sheet/Keep/Forms • Create Virtual Machine using VMware workstation for Windows/Linux • Create Web server (WAMP/XAMP/APACHE) on Virtual Machine • Create an account on AWS or Azure, or Google Cloud Platform	30

	• Create an account on Google Cloud Platform. a) Create a project and access BigQuery. b) Query data directly from Google Sheets. c) Create tables and views using BigQuery • Launch an EC2 instance with a specified configuration and configure Block-Based storage • Create and Configure File-Based storage on EC2 instance • Create and Configure Object-Based storage on EC2 instance • Create instance of Amazon Sagemaker notebook	
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: • Dr. Anand Nayyar Handbook of Cloud Computing BPB Publication • Toby Velte, Anthony Velte, Robert C Cloud Computing: A Practical Approach McGraw Hill Professional • Noah Gift, Alfredo Deza Cloud Computing for Data Analysis Pragmatic AI Labs • Valliappa Lakshmanan Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines O'Reilly Media • Abhishek Mishra Machine Learning in the AWS Cloud: Add Intelligence to Applications with Amazon SageMaker Wiley Publication		

*Applicable for courses having practical component.

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<tr><th colspan="5">Part A - Introduction</th></tr>
<tr><td>Subject</td><td colspan="4">BCA (Data Science)</td></tr>
<tr><td>Semester</td><td colspan="4">V</td></tr>
<tr><td>Name of the Course</td><td colspan="4">Computer Networks</td></tr>
<tr><td>Course Code</td><td colspan="4">B23-CDS-503</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="4">CC-C5</td></tr>
<tr><td>Level of the course (As per Annexure-I</td><td colspan="4">300-399</td></tr>
<tr><td>Pre-requisite for the course (if any)</td><td colspan="4">None</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="4">After completing this course, the learner will be able to:
1. Understand the fundamental concepts of Computer Networks and their applications.
2. Develop problem-solving skills related to network design, implementation, and troubleshooting.
3. Implement network protocols and configure network devices.
4. Know about emerging technologies in computer networks.
5* implement the various aspects of computer network.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td>1</td><td colspan="2">4</td></tr>
<tr><td>Contact Hours</td><td>3</td><td>2</td><td colspan="2">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="3">Time: 3 Hrs.(T), 3Hrs.(P)</td></tr>
<tr><th colspan="5">Part B- Contents of the Course</th></tr>
<tr><td colspan="5"><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. 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.
Practicum will be evaluated by an external and an internal examiner. Examination will be of three-hour duration.</td></tr>
<tr><th>Unit</th><th colspan="3">Topics</th><th>Contact Hours</th></tr>
<tr><td>I</td><td colspan="3">Introduction to Computer Networks:
Overview of Computer Networks: Definition and Objectives, Applications and Examples Network Components and Architecture
Network Models: OSI Model: Layers and Functions. TCP/IP Model: Layers and Functions Comparison between OSI and TCP/IP Models
Network Topologies: Physical vs. Logical Topologies, Common</td><td>11</td></tr>
</table>

	Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology **Data Transmission:** Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency **Networking Devices:** Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device.	
II	**Data Link Layer and Networking Protocols**: **Data Link Layer Fundamentals:** Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms. **Ethernet:** Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods **Network Protocols:** Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation.	11
III	**Network Layer and Transport Layer**: **Network Layer:** IP Routing: Static vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT) **Transport Layer:** TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP **Network Security Fundamentals:** Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNs, Encryption	11
IV	**Application Layer and Emerging Technologies**: **Application Layer Protocols:** HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution Network Applications: Web Browsing, Email Communication, File Transfer, Voice over IP (VoIP) and Streaming. **Emerging Technologies:** Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking **Network Management:** SNMP: Simple Network Management Protocol, Network Monitoring Tools and Techniques.	12
V*	**Practicum**: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Configure Basic Network Settings: a) IP Address Configuration b) Subnet Mask and Gateway Settings • Implement Network Protocols: a) Write a simple Python script to perform DNS resolution. b) Implement a basic HTTP client-server application. • Network Simulation: a) Use network simulation tools to design and simulate network topologies. b) Configure routers and switches in a simulated environment. • Performance Measurement: a) Measure network performance using tools like `ping`, `traceroute`, and `iperf`. b) Analyze network traffic using Wireshark. • Set Up a Simple Web Server: a) Deploy a basic web server and configure HTTP/HTTPS access.	30

	• Network Security Lab: a) Implement basic firewall rules and VPN configurations. b) Perform vulnerability scanning and analyze results. • Network Troubleshooting: a) Diagnose and resolve common network issues. b) Use troubleshooting commands and techniques to fix connectivity problems.	

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:

- Andrew S. Tanenbaum, "Computer Networks", Pearson Education
- James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", Pearson
- Behrouz A. Forouzan, "Data Communications and Networking", McGraw-Hill Education.
- Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann.

* Applicable for courses having practical components.

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<tr><th colspan="4">Part A - Introduction</th></tr>
<tr><td>Subject</td><td colspan="3">BCA (Data Science)</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Data Visualization</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CDS-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">Basic Knowledge of Python and Excel</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 basic concepts and principles of data visualization.
2. Know about the various techniques for data visualization.
3. Know about the various techniques for advanced data visualization.
4. Apply the various data visualization techniques.
5*. Implement the data visualization techniques.</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 Visualization**: Definition and importance of data visualization, Principles of effective data visualization. **Types of data visualization:** charts, graphs, maps, etc. **Data visualization process:** data acquisition, exploration, analysis, visualization, interpretation, Ethical considerations and best practices in data visualization.	11
II	**Basic Data Visualization Techniques**: **Introduction to basic visualization tools:** Excel, Google Sheets, Tableau Public, etc., **Creating and customizing simple charts:** bar charts, line charts, pie charts, scatter plots, etc., Adding labels, titles, legends, and annotations to visualizations, Data filtering and sorting techniques for effective visualization, Exporting and sharing visualizations.	11
III	**Advanced Data Visualization Techniques:** **Introduction to advanced visualization libraries:** Matplotlib, Seaborn, Plotly, etc., Creating complex and interactive visualizations using Python, Heatmaps, box plots, violin plots, histograms, etc., Geographic visualization: maps, choropleth maps, geospatial data visualization, Dashboard creation and customization	11
IV	**Data Visualization Best Practices**: Choosing the right visualization for different types of data and analysis goals. **Design principles for effective visualization:** color theory, layout, typography, etc. **Data storytelling:** conveying insights and narratives through visualizations, Accessibility and inclusivity considerations in data visualization, Critique and evaluation of data visualizations	12
V*	The following activities be carried out/ discussed in the labduring the semester. Programming Lab: **Visualization using Excel** • Creating bar charts, pie charts, line charts, and scatter plots • Conditional formatting and sparkline charts • Using Pivot Charts for summarization • Customizing chart elements: axis, labels, legends, titles **Visualization using Google Sheets** • Inserting charts: column, bar, line, area, combo, pie, scatter • Real-time data visualization with Google Finance • Collaborative visualization and embedding charts • Using FILTER and QUERY functions for chart data **Visualization using Matplotlib (Python)** • Basic plotting (line, bar, scatter, histogram) • Customization: labels, titles, colors, grid, styles • Subplots and figure control • Saving plots to files (PNG, PDF) **Visualization using Seaborn (Python)** • Relational plots: scatterplot, lineplot • Categorical plots: barplot, boxplot, violinplot, swarmplot • Distribution plots: distplot, histogram, KDE	30

	• Heatmaps and correlation matrices • Themes and aesthetics **Visualization using Plotly (Python)** • Static and interactive charts: line, bar, scatter, pie • 3D plots and surface charts • Dashboards and layout configuration • Exporting interactive charts (HTML)	

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:

- "Data Visualization: A Practical Introduction" by Kieran Healy
- "Python Data Visualization: An Introduction to Data Visualization in Python with Matplotlib, Seaborn, and Plotly" by Adel Osmani
- "The Visual Display of Quantitative Information" by Edward Tufte
- "Story telling with Data : A Data Visualization Guide for Business Professionals " Cole Nussbaumer Knaflic, Wiley.

*Applicable for courses having practical components.

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<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 (Data Science)</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Internet of Things</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CDS-602</td></tr>
<tr><td>Course Type: (CC/MCC/MDC/CC-M/DSEC/VOC/DSE/PC/AEC/ VAC)</td><td colspan="3">CC-B6</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">None</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. Understand about IoT.
2. Know about IoT devices.
3. learn protocols used in IoT.
4. Learn Arduino programming.

5* To work on program based on IoT using Arduino.</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>
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.
Practicum will be evaluated by an external and an internal examiner. The examination will be of three-hour duration.</td></tr>
</table>

Unit	Topics	Contact Hours
I	**Introduction to Internet of Things**: Introduction, Definition and Characteristics, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels & Deployment Templates.	11
II	**IoT Physical Devices & Domain Specific IoT:** IoT Devices, Boards –Arduino - Raspberry PI – ESP 8266, ESP 8233 – About the board, Sensors, Actuators, Gateways. **Domain Specific IoT:** Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle.	11
III	**IoT & M2M-** Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT. **Protocols for IoT:** Infrastructure Protocols: Routing Protocol, IEEE 802.15.4, Bluetooth Low Energy, Z-Wave, Zigbee, MQTT Protocol. **Protocols For IoT Service Discovery:** multicast Domain Name System (mDNS).	11
IV	**Programming IoT Using Python:** Python basics for IoT applications, Installing and using Python on IoT devices like Raspberry Pi, GPIO programming with Python, Interfacing sensors and actuators using Python, Reading and writing data using Python, Working with communication protocols in Python, Sending data to the cloud using Python, Accessing APIs and parsing JSON data, Building simple IoT applications using Python.	12
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: 1. **Set up Python on Raspberry Pi/ESP32/ESP8266**: Install Python and necessary libraries, configure Wi-Fi and SSH. 2. **Basic Python scripting on IoT device**: Write and execute simple Python scripts (LED blinking, system info displays). 3. **GPIO programming using Python**: Control LEDs, buzzers, and buttons using GPIO pins on Raspberry Pi or ESP. 4. **Interfacing Sensors with Python**: Read data from sensors like DHT11 (temperature/humidity), Ultrasonic sensor, or LDR using Python. 5. **Actuator control using Python**: Control actuators like servo motors, DC motors, and relays through Python scripts. 6. **Sensor data logging**: Read sensor data and log it to a local file or CSV using Python. 7. **Real-time data visualization**: Plot sensor data in real-time using Python libraries such as Matplotlib or Plotly.	30

	8. **Communication using protocols (I2C, SPI, UART)**: Connect and communicate with devices like displays or ADCs using I2C or SPI via Python. 9. **Send sensor data to cloud platforms**: Use Python to send data to cloud services like ThingSpeak, Google Sheets, or MQTT broker. 10. **Access and parse JSON from web APIs**: Use Python to fetch and display weather or location data from public APIs. 11. **Build a simple home automation system**: Use Python to control appliances (lights, fans) via web interface or smartphone.	

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:

- Arshdeep Bahga, Vijay Madisetti, The Internet of Things: A Hands on Approach Universities press.
- RajkumarBuyya and Amir VahidDastjerdi, Internet of Things-Principles and Paradigms Edition.
- Brian Evans Beginning Arduino Programming, Apress.
- Olivier Hersent, David Boswarthick, Omar Elloumi,The Internet of Things: Key Applications and Protocols–Wiley.
- Pethuru Raj and AnupamaC.Raman, The Internet of Things: Enabling Technologies, Platforms and Use Cases- CRC Press.

*Applicable for courses having practical components.

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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 (Data Science)</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Basics of Neural Network and Deep Learning</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CDS-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">Knowledge of basics of machine learning and python.</td></tr>
<tr><td>Course Learning Outcomes(CLO):</td><td colspan="3">After completing this course, the learner will be able to:
1. learn the basics of neural networks and deep learning.
2. understand deep learning using python.
3. Understand CNN and RNN.
4. Apply deep learning in real-life.
5*. Implement the various tools and techniques used in 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>
<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))
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<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.
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	**Introduction to Neural Networks and Deep Learning:** Overview of AI, Machine Learning, and Deep Learning, Introduction to artificial neural networks, Biological vs artificial neurons, Structure of a perceptron, Multilayer Perceptrons (MLP), Activation functions – sigmoid, tanh, ReLU, Introduction to forward and backward propagation, Loss functions – MSE and cross-entropy, Concept of learning rate and epochs.	11
II	**Basics of Deep Learning with Python:** Overview of Python libraries: Introduction to TensorFlow and Keras, Building a basic neural network using Keras Sequential API, Compiling and training a model, Model evaluation – accuracy, loss, validation set, Overfitting and underfitting, Techniques to avoid overfitting – dropout, early stopping.	11
III	**Introduction to CNN and RNN:** Understanding convolution and pooling operations, Basics of Convolutional Neural Networks (CNN), Applications of CNN in image classification, Introduction to Recurrent Neural Networks (RNN), Concept of time series and sequential data, Simple RNN and LSTM (basic concept only), Introduction to use cases – image recognition, text classification.	12
IV	**Applications:** Case studies of neural networks in real-world problems – digit recognition, spam detection, sentiment analysis, Overview of transfer learning using pre-trained models, Introduction to autoencoders and basic anomaly detection, Ethical concerns in deep learning – bias, fairness, and explainability.	11
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: • Install and configure TensorFlow/Keras on local or cloud platforms • Build and train a basic MLP model on the MNIST dataset • Implement activation functions and visualize their behavior • Use dropout and early stopping in training • Apply CNN to simple image classification tasks • Build a basic RNN for time series or text classification • Mini project involving real-world data (e.g., classification, regression, prediction)	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	**End-Term Examination:** A three-hour exam for both theory and practicum. **End Term Exam Marks:**

• Seminar/Demonstration/Viva-voce/Lab records etc.: 10 • Mid-Term Exam: NA	**70(50(T)+20(P))**

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Ian Goodfellow, Yoshua Bengio, and Aaron Courville – *Deep Learning*, MIT Press
- François Chollet – *Deep Learning with Python*, Manning Publications
- Michael Nielsen – *Neural Networks and Deep Learning*, available online at http://neuralnetworksanddeeplearning.com
- Aurélien Géron – *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly Media
- Charu C. Aggarwal – *Neural Networks and Deep Learning: A Textbook*, Springer
- Nikhil Buduma – *Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms*, O'Reilly Media
- Antonio Gulli, Amita Kapoor, and Sujit Pal – *Deep Learning with Keras and TensorFlow*, Packt Publishing.

*Applicable for courses having practical components.

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<tr><th colspan="4">Part A - Introduction</th></tr>
<tr><td>Subject</td><td colspan="3">BCA (Data Science)</td></tr>
<tr><td>Semester</td><td colspan="3">VI</td></tr>
<tr><td>Name of the Course</td><td colspan="3">Design and Innovation Thinking</td></tr>
<tr><td>Course Code</td><td colspan="3">B23-CAP-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">Must have 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. Propose real-time innovative product designs and Choose appropriate frameworks, strategies, techniques during prototype development.
2. Know wicked problems and how to frame them in a consensus manner that is agreeable to all stakeholders using appropriate frameworks, strategies, techniques during prototype development.
3. Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products
4. Understand the importance of prototyping in the innovation journey
5*. to implement the various innovative designs.</td></tr>
<tr><td rowspan="2">Credits</td><td>Theory</td><td>Practical</td><td>Total</td></tr>
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Instructions for Paper- Setter

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The candidate will have to 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.

Unit	Topics	Contact Hours
I	**Basics of Design Thinking:** Understand the concept of innovation and its significance in business, understanding creative thinking process and problem solving approaches, Know Design Thinking approach and its objective. **Design Thinking and customer centricity** – real world examples of customer challenges, use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product. Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc., Stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement	12
II	**Learning to Empathize and Define the Problem:** Know the importance of empathy in innovation process – how can students develop empathy using design tools, Observing and assimilating information, Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences, Wicked problems, Identifying wicked problems around us and the potential impact of their solutions	11
III	**Ideate, Prototype and Implement**: Know the various templates of ideation like brainstorming, systems thinking, Concept of brainstorming – how to reach consensus on wicked problems, Mapping customer experience for ideation, Know the methods of prototyping, purpose of rapid prototyping, Implementation	11
IV	**Feedback, Re-Design & Re-Create**: Feedback loop, focus on User Experience, address ergonomic challenges, user focused design, Final concept testing, Final Presentation – Solving Problems through innovative design concepts & creative solution	11
V*	Practicum: Students are advised to do laboratory/practical practice not limited to but including the following types of problems: **Mind Mapping**: Students map out what they understand by innovation and creativity. **Case Study Discussion**: Examples from Airbnb, IDEO, Apple, and Netflix – what makes them innovative?	30

	Group Activity: Reverse Engineering – "Why do you think this product succeeded or failed?" **Empathy Walk / Interview**: Students interact with real users (or conduct surveys) to understand problems. **Persona Creation**: Based on user interviews, create user personas highlighting needs, pain points, behaviors. **Empathy Mapping**: Fill the empathy map – "Says, Thinks, Does, Feels" for target users. **Problem Statement Framing**: Convert insights from empathy into actionable problem definitions. **Wicked Problem Identification**: Brainstorm and identify complex social/technological/local problems. **Whys & Fishbone Diagram**: Use root cause analysis to understand the deeper problem. **Brainstorming Session**: Generate 50+ ideas in 30 minutes. **SCAMPER Technique**: Apply SCAMPER (Substitute, Combine, Adapt…) to refine ideas. **Customer Journey Mapping**: Understand touchpoints and generate ideas to improve experience. **Rapid Prototyping**: Use paper, cardboard, digital mockups (Canva/Figma) to create low-fidelity prototypes. **Storyboarding**: Visual storytelling of how users will interact with the solution. **Wireframes / Mockups**: Create a digital layout of app/website/product (optional tech tool: Figma/PowerPoint) **Feedback from Peers/Target Users**: Use Likert scale or open-ended questions for user testing. **Redesign Based on Feedback**: Refine the prototype and re-test. **Final Presentation & Showcase**: Students present their problem, process, prototype, and insights.	

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:

- E Balaguruswamy, Developing Thinking Skills (The way to Success), Khanna Book Publishing Company
- Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harvard Business Review
- 8 steps to Innovation by R T Krishnan & V Dabholkar, Collins Publishing

- Design Thinking by Nigel Cross, Bloomsbury

*Applicable for courses having practical component.