ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

MANGALORE UNIVERSITY

(Accredited by NAAC)

ಕ್ರಮಾಂಕ/ No. : MU/ACC/CR 3/2023-24/A2

ಕುಲಸಚಿವರ ಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ – 574 199
Office of the Registrar
Mangalagangothri – 574 199
ದಿನಾಂಕ/Date:10.10.2023

NOTIFICATION

Sub: Revised syllabus of Career Oriented Programme in Data Analysis, Cloud Computing and Cyber Security

Ref: Academic Council approval vide agenda No.: ಎಸಿಸಿ:ಶೈ.ಸಾ.ಸ.2:24(2023–24) dtd 04.10.2023.

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The revised syllabus of Career Oriented Programme in Data Analysis, Cloud Computing and Cyber Security which is approved by the Academic Council at its meeting held on 04.10.2023 is hereby notified for implementation with effect from the academic year 2023-24 and onwards.

Copy of the Syllabus shall be downloaded from the University Website (www.mangaloreuniversity.ac.in)

REGISTRAR

To

1. The Registrar (Evaluation), Mangalore University.
2. The Chairman, UG BOS in Computer Science and Computer Applications, Dept. of Computer Science, Mangalore University.
3. The Principals of the College Concerned.
4. The Superintendent (ACC), O/o the Registrar, Mangalore University.
5. The Asst. Registrar (ACC), O/o the Registrar, Mangalore University.
6. The Director, DUIMS, Mangalore University – with a request to publish in the website.
7. Guard File.

UGC CAREER ORIENTED COURSE ON

DATA ANALYSIS, CLOUD COMPUTING AND CYBER SECURITY

Preamble:

Data analysis is of paramount importance in various fields and industries due to its numerous benefits and contributions. Data analysis is a versatile and indispensable tool in today's data-driven world. It empowers individuals, organizations, and governments to make informed decisions, improve processes, and drive innovation across various domains. Data analysis is useful for better planning and forecasting, performing risk management, marketing optimization, quality improvement, fraud detection, etc. In this context, this course will be of significance to the student community for better employability in industry sectors.

Cloud computing is a technology that has revolutionized the IT industry and business operations in recent years. Its importance is reflected in various ways. Importance of Cloud Computing include cost efficiency, flexibility and accessibility, security and compliance, disaster recovery, etc. Several job opportunities in cloud computing include but not limited to Cloud Architect, Cloud Developer, DevOps Engineer, Cloud Administrator, Cloud Sales and Marketing, etc. The job opportunities in cloud computing are diverse and continue to expand as more organizations embrace cloud technologies. Cloud certifications from providers like AWS, Microsoft Azure, and Google Cloud can also enhance qualifications in this field.

Cyber security is of paramount significance in today's digitally interconnected world due to the protection of sensitive data, prevention of data breaches, financial stability, national security, protection of intellectual property, privacy preservation, maintaining trust, etc. Cyber security is essential for protecting individuals, businesses, governments, and society as a whole from the growing threats in the digital age. Its significance extends to financial stability, national security, privacy, and the preservation of trust and data integrity in an increasingly interconnected world. The field of cyber security has created a vast number of job opportunities, contributing to economic growth and job security. As cyber threats continue to evolve, there is a growing demand for cyber security professionals. The field of cyber security offers a wide range of job opportunities due to the increasing importance of protecting digital assets and information in today's interconnected world. Some of the most common and sought-after job roles in cyber security include cyber security analyst, security consultant, security engineer: penetration tester (ethical hacker), compliance officer/auditor, forensic analyst, threat intelligence analyst: block chain security expert and many more.

Course objectives:

The objectives of this career oriented course can vary depending on the level of the course (certificate, diploma and advanced diploma). However, some common objectives are as follows:

Data Analysis:

- Gain a fundamental understanding of key data concepts, such as data types, data structures, data collection methods, and data sources.
- Learn how to clean and pre-process data to ensure its quality and suitability for analysis.
- Develop skills in EDA techniques to explore and visualize data, identify patterns, trends, and outliers, and gain insights that can inform further analysis.
- Acquire skills in data visualization to effectively communicate insights and findings through charts, graphs, and interactive dashboards.
- Familiarize with data analysis software and tools such as Python, R, Excel, and data visualization libraries (e.g., Matplotlib, ggplot2, Tableau).
- Understand the ethical considerations and privacy concerns related to data analysis, including issues of consent, data anonymization, and responsible data handling.
- Learn project management skills specific to data analysis, including data project planning, data collection, analysis, and reporting.
- Provide opportunities for hands-on practice with real datasets and projects to reinforce theoretical knowledge.

Cloud Computing:

- Gain a fundamental understanding of cloud computing concepts, including its definition, characteristics, and service models (e.g., IaaS, PaaS, SaaS).
- Learn about cloud deployment models (e.g., public, private, hybrid) and their implications.
- Familiarize with major cloud service providers (e.g., AWS, Azure, Google Cloud) and their offerings.
- Learn how cloud providers manage and maintain infrastructure resources.
- Learn about identity and access management (IAM), encryption, and security best practices in the cloud.
- Gain hands-on experience deploying and managing virtual machines and containers in the cloud
- Understand cloud networking concepts, including virtual private clouds (VPCs), subnets, and routing.
- Discover strategies for optimizing cloud costs, monitoring usage, and managing billing in a cloud environment.
- Explore real-world case studies and examples of how organizations have successfully implemented cloud solutions to solve business problems.

Cyber Security:

- Understand procedures to protect sensitive data from unauthorized access, disclosure, or theft.
- Process to verify the identity of users, devices, or systems attempting to access resources.

- How to determine what actions or resources users, devices, or systems are permitted to access after authentication.
- Implementation of encryption and other security measures to protect data at rest, in transit, and during processing.
- Know about monitoring systems and networks for signs of suspicious or malicious activity.
- Identify and address vulnerabilities in systems, software, and configurations to reduce the attack surface and minimize the risk of exploitation.
- Develop and enforce security policies and procedures that define acceptable behaviour, access controls, and security requirements within an organization.
- Security Testing and Assessment: Conduct regular security assessments, penetration testing, and vulnerability scanning to identify weaknesses and gaps in security defences.

Scheme of the course:

FIRST YEAR (LEADING TO CERTIFICATE)

Paper	Instruction (Hr.)	Duration of Examination (Hr.)	Marks for Final Exam	Marks for Internal Exam	Total Marks
CDCCS Paper-I	03	03	100	50	150
Practical-I	03	03	100	50	150

SECOND YEAR (LEADING TO DIPLOMA)

Paper	Instruction (Hr.)	Duration of Examination (Hr.)	Marks for Final Exam	Marks for Internal Exam	Total Marks
CDCCS Paper-II	03	03	100	50	150
Practical-II	03	03	100	50	150

III YEAR (LEADING TO ADVANCED DIPLOMA)

Paper	Instruction (Hr.)	Duration of Examination (Hr.)	Marks for Final Exam	Marks for Internal Exam	Total Marks
CDCCS Paper-III	03	03	100	50	150
Practical-III	03	03	100	50	150
Project	03	--	100	--	100

Every student is expected to take up a project work under a guide relating to the areas of their study and submit a report containing detailed discussion about the project which will have two valuations (1 internal and 1 external) for a maximum of 50 marks. A viva voce examination is to be conducted based on their project report by the external examiner/examiners for a maximum of 50 marks.

Pedagogy:

- Tutorial and Group Discussion
- Practical Experience
- Projects and Assignments
- Course Presentation
- Industrial Visit
- Seminars and Workshops

FIRST YEAR:

CDCCS PAPER-I:

1. Introduction to Data Analysis: Introduction to data analysis and its importance, Types of data (categorical, numerical, ordinal), Data sources and data collection methods, Introduction to data analysis tools (Excel/R)
2. Data Cleaning and Pre-processing: Data cleaning techniques-handling missing data, outliers; Data pre-processing: data normalization, scaling,
3. Introduction to data visualization: Types of charts and graphs (bar charts, histograms, scatter plots), Data visualization tools
4. Introduction to Cloud Computing: Historical context and evolution of cloud computing, Benefits and challenges of cloud computing, Key cloud computing providers (e.g., AWS, Azure, Google Cloud)
5. Cloud Service Models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Function as a Service (FaaS), Comparing service models
6. Cloud Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud
7. Introduction to Cyber security: Definition, Importance of cyber security, Key cyber security concepts and terminology, Ethical and legal aspects of cyber security
8. Cyber Threats and Attack Vectors: Common cyber threats (e.g., malware, phishing, ransomware, Attack vectors and techniques, Case studies of notable cyber attacks
9. Security Principles and Practices: Security principles (confidentiality, integrity, availability), Defense-in-depth and layered security, Security policies and best practices

Text Books:

- "Introduction to Data Science" by Jeffrey Stanton
- "Data Science for Business" by Foster Provost and Tom Fawcett.
- "Introduction to the Practice of Statistics" by David S. Moore, George P. McCabe, and Bruce A. Craig.
- "Cloud Computing: Principles and Paradigms" by Rajkumar Buyya, James Broberg, and Andrzej Goscinski:
- "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl.
- "Cybersecurity Essentials" by Charles J. Brooks

Practical-I

1. Analyze a dataset of stock prices to identify trends and patterns.
2. Clean and pre-process a dataset with missing values, outliers, and inconsistencies.
3. Normalize and scale features in a dataset for analysis.
4. Create visualizations (e.g., bar charts, histograms, scatter plots) to represent data distributions and relationships.

5. Visualize the geographical distribution of COVID-19 cases using maps.
6. Choose a specific dataset (e.g., global GDP, COVID-19 statistics) and create informative data visualizations.
7. Sign up for a free tier account with a cloud provider like AWS (Amazon Web Services), Azure (Microsoft), or GCP (Google Cloud Platform).
8. Create and manage strong, complex passwords.
9. Identify phishing emails and distinguish them from legitimate messages.
10. Set up a controlled environment (sandbox) for analyzing malware samples.
11. Analyze and identify characteristics of different types of malware (e.g., viruses, Trojans, ransomware).
12. Analyze phishing URLs for malicious intent.

SECOND YEAR:

CDCCS PAPER-II:

1. Descriptive Statistics: Measures of central tendency (mean, median, mode), Measures of variability (range, variance, standard deviation, Percentiles and quartiles
2. Probability and Distributions: Basic probability concepts, Probability distributions (normal, binomial, Poisson), Sampling and the Central Limit Theorem
3. Inferential Statistics: Hypothesis testing, t-tests and p-values, Confidence intervals; Correlation and Regression: Correlation analysis, Linear regression, Interpretation of regression results
4. Regression Analysis: Multiple linear regression, Logistic regression, Ridge and Lasso regression
5. Virtualization in the Cloud: Virtual machines vs. containers, Hypervisors and containerization technologies, Orchestration and management tools (e.g., Docker, Kubernetes)
6. Cloud Storage and Databases: Cloud storage services (e.g., Amazon S3, Google Cloud Storage), Database services (e.g., Amazon RDS, Azure SQL Database), Data backup and recovery in the cloud
7. Cloud Security: Cloud security challenges and best practices, Identity and access management (IAM), Encryption and data protection, Compliance and governance in the cloud.
8. Network Security: Network security fundamentals, Firewalls, intrusion detection systems (IDS), and intrusion prevention systems (IPS), Virtual Private Networks (VPNs) and secure network design
9. Cryptography and Data Protection: Basics of cryptography, Encryption algorithms and protocols, Public key infrastructure (PKI) and digital certificates

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- "Cloud Computing: Principles and Paradigms" by Rajkumar Buyya, James Broberg, and Andrzej Goscinski:
- "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl.
- "Cyber security Essentials" by Charles J. Brooks.
- "Cyber security and Cyber war: What Everyone Needs to Know" by P.W. Singer and Allan Friedman

Practical-II:

1. Calculate descriptive statistics (e.g., mean, median, standard deviation) for a dataset.
2. Build a simple linear regression model to predict student test scores based on study time.
3. Launch a virtual machine (EC2 in AWS, VM in Azure, or Compute Engine in GCP).
4. Configure the virtual machine with specific hardware, operating system, and storage options.
5. Connect to the virtual machine remotely using SSH (Secure Shell) or RDP (Remote Desktop Protocol).
6. Launch a virtual machine (EC2 in AWS, VM in Azure, or Compute Engine in GCP).
7. Configure the virtual machine with specific hardware, operating system, and storage options.
8. Connect to the virtual machine remotely using SSH (Secure Shell) or RDP (Remote Desktop Protocol).
9. Set up cloud monitoring and logging to track resource utilization, performance, and security.
10. Identify suspicious or malicious network activity.
11. Install and configure antivirus and antimalware software.
12. Encrypt sensitive data using encryption tools or techniques.
13. Understand the principles of symmetric and asymmetric encryption.
14. Recognize social engineering tactics (e.g., phishing calls, pretexting) and respond appropriately.
15. Set up a home network with proper security measures (firewall, Wi-Fi encryption, strong router passwords).

THIRD YEAR

CDCCS PAPER-III:

1. Multivariate Analysis: Introduction to multivariate analysis, Principal Component Analysis (PCA), Factor Analysis
2. Classification and Clustering: Classification algorithms (e.g., decision trees, random forests), Clustering algorithms (e.g., k-means, hierarchical clustering)
3. Introduction to Data Analysis with Python: Setting up a Python environment (e.g., Jupyter Notebook), Python libraries for data analysis (NumPy, Pandas), Data loading and manipulation with Python, Hands-On Data Analysis with Python, Data visualization and basic statistical analysis in Python, Real-world datasets and case studies
4. Networking in the Cloud: Virtual Private Cloud (VPC), Content Delivery Network (CDN), Load balancing and auto-scaling, Network security groups and firewalls
5. Cloud Case Studies and Use Cases: Real-world examples of cloud adoption, Industry-specific use cases, Cloud success stories and challenges
6. Security Risk Management: Risk assessment and analysis, Risk mitigation strategies, Security frameworks (e.g., NIST Cyber security Framework)
7. Access Control and Identity Management: Access control models (DAC, MAC, RBAC), Authentication and authorization, Identity and access management (IAM) solutions
8. Security Compliance and Regulations: Industry-specific regulations (e.g., HIPAA, GDPR), Compliance frameworks (e.g., ISO 27001), Legal and ethical considerations in cyber security

Text Books:

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Practical-III:

1. Apply k-means clustering to group customers based on their purchase behavior.
2. Create a simple serverless function (e.g., AWS Lambda, Azure Functions, Google Cloud Functions) to respond to HTTP requests or events.
3. Configure access control and permissions using Identity and Access Management (IAM) or similar services.
4. Set up encryption for data at rest and in transit.
5. Create and deploy a container (e.g., Docker) in a cloud environment.
6. Build a simple serverless application (e.g., a chatbot, image processing service) using cloud-native services.
7. Configure a personal or network firewall to block or allow specific traffic.
8. Create firewall rules to protect a network from unauthorized access.
9. Capture and analyze network traffic using packet capture tools (e.g., Wireshark).
10. Perform regular scans and remove detected threats.
11. Configure web browsers for enhanced security and privacy.
12. Recognize and avoid potentially harmful websites.
13. Keep operating systems and software up to date by applying patches and updates.
14. Develop a patch management strategy.
15. Encrypt files before transferring or storing them in the cloud.
16. Practice secure file sharing and storage practices.
17. Secure a Wi-Fi network by changing default passwords, enabling encryption, and using strong pre-shared keys (PSKs).
18. Familiarize yourself with common security tools such as Nmap, Nessus, Snort, and OSSEC.

FINAL PROJECT

Students will work on a data analysis/cloud computing/cyber security project using the skills learned throughout the course. Presentation of final projects and discussion.

Case Studies and Projects:

- Work on cloud-related projects, such as deploying a web application, setting up a data analytics pipeline, or building a cloud-native micro-services architecture.
- Work on data analysis such as analyzing and forecast monthly sales data for a retail store, Monitor and visualize data in real-time, etc.
- Work on a comprehensive data science capstone project that encompasses all stages of the data science process, from data collection to model deployment.
- Create a tool that assesses the strength of user passwords and provides recommendations for stronger passwords.
- Use network scanning tools like Nmap to scan your home network for open ports and vulnerabilities.
- Develop educational materials (e.g., presentations, pamphlets) to raise awareness about common cyber security threats and best practices.
- Configure a network firewall (e.g., pfSense, iptables).
- Test the firewall's effectiveness by simulating attacks and intrusion attempts.
- Monitor network traffic and detect suspicious or malicious activity.
- Design a secure network architecture for an organization, considering defense-in-depth principles.
- Build scripts or tools for automating security tasks (e.g., log analysis, vulnerability scanning).
- Evaluate the security of Internet of Things (IoT) devices, such as smart home devices or industrial sensors.