**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
Syllabus of *B.Sc. in Data Science*
**Effective from academic session 2023-2024**

**SEMESTER - 5**

**Paper Code: BDS501**
**Paper Name:** *Discrete Mathematics*
**Credits: 5**

## MODULE 1: Introduction to Discrete Mathematics
- ● - Basic terminologies and concepts in discrete mathematics
- ● - Sets, set operations, and set theory
- ● - Functions and relations

## MODULE 2: Logic and Proof Techniques
- ● - Propositional logic: syntax, semantics, and truth tables
- ● - Logical connectives and truth functions
- ● - Predicates and quantifiers
- ● - Proofs: direct proofs, proof by contradiction, and proof by contrapositive

## MODULE 3: Methods of Proof
- ● - Mathematical induction
- ● - Strong induction
- ● - Recursive definitions and structural induction

## MODULE 4: Combinatorics
- ● - Basic counting principles: multiplication rule, addition rule, and inclusion-exclusion principle
- ● - Permutations and combinations
- ● - Binomial coefficients and Pascal's triangle
- ● - The pigeonhole principle

## MODULE 5: Relations and Functions
- ● - Relations: properties, equivalence relations, and partial orders
- ● - Functions: injective, surjective, and bijective functions
- ● - Composition of functions and inverse functions

## MODULE 6: Graph Theory
- ● - Basic terminologies: vertices, edges, paths, and cycles
- ● - Graph representations: adjacency matrix and adjacency list
- ● - Connectivity: connected graphs, components, and bridges
- ● - Eulerian and Hamiltonian paths and cycles

## MODULE 7: Trees
- ● - Definitions and properties of trees
- ● - Tree traversal algorithms: depth-first search and breadth-first search
- ● - Spanning trees and minimum spanning trees
- ● - Applications of trees in computer science

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**MODULE 8: Boolean Algebra**
- ● - Boolean functions and Boolean expressions
- ● - Logic gates and Boolean circuits
- ● - Simplification of Boolean expressions: Karnaugh maps and Quine-McCluskey method
- ● - Boolean algebra theorems and applications

**MODULE 9: Discrete Probability**
- ● - Sample spaces, events, and probability axioms
- ● - Conditional probability and independence
- ● - Counting techniques in probability
- ● - Discrete probability distributions: binomial and geometric distributions

**MODULE 10: Recurrence Relations**
- ● - Introduction to recurrence relations
- ● - Solving linear homogeneous recurrence relations with constant coefficients
- ● - Solving linear non-homogeneous recurrence relations
- ● - Generating functions and solving recurrence relations using generating functions

**References:**

**1.** *Discrete Mathematical Structures*, Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, Pearson/Prentice Hall, 2009

**2.** *Discrete Mathematics and Its Applications*, Kenneth Rosen, McGrawhill Education, 2017

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Paper Code: BDS502& BDS592**
**Paper Name:** *Natural Language Processing*
**Credits: 3+2**

## 1. Introduction to Natural Language Processing
- ●     - Definition and scope of NLP
- ●     - Applications of NLP
- ●     - NLP challenges and limitations

## 2. Text Preprocessing
- ●     - Tokenization
- ●     - Stop word removal
- ●     - Stemming and lemmatization
- ●     - Text normalization

## 3. Language Modeling
- ●     - N-gram models
- ●     - Hidden Markov Models (HMM)
- ●     - Neural language models

## 4. Syntactic Analysis
- ●     - Part-of-speech tagging
- ●     - Phrase structure parsing
- ●     - Dependency parsing

## 5. Semantic Analysis
- ●     - Word sense disambiguation
- ●     - Named entity recognition
- ●     - Semantic role labeling

## 6. Sentiment Analysis
- ●     - Opinion mining
- ●     - Sentiment classification techniques
- ●     - Aspect-based sentiment analysis

## 7. Machine Translation
- ●     - Rule-based machine translation
- ●     - Statistical machine translation
- ●     - Neural machine translation

## 8. Information Extraction
- ●     - Named entity recognition
- ●     - Relation extraction
- ●     - Event extraction

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**9. Question Answering**

- ● - Question classification
- ● - Passage retrieval
- ● - Answer extraction

**10. Advanced Topics**

- ● - Deep learning for NLP
- ● - Neural network architectures (e.g., recurrent and convolutional models)
- ● - Transfer learning in NLP

**11. NLP Applications and Research Trends**

- ● - Chatbots and virtual assistants
- ● - Text summarization
- ● - Dialogue systems
- ● - Recent developments and future directions in NLP

**12. Project Work and Presentations**

- ● - Students will work on a hands-on NLP project and present their findings to the class.

**References:**

1. "Natural Language Processing: Basic Techniques and Emerging Trends" by Nitin Indurkhya and Fred J. Damerau, CRC Press.

2. "Natural Language Processing: A Paninian Perspective" by Amba Kulkarni, Rajeev Sangal, and Vineet Chaitanya, Prentice-Hall of India.

3. "Foundations of Natural Language Processing" by Pushpak Bhattacharyya, Pearson Education India.

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**SEMESTER - 6**

**Paper Code: BDS601 & BDS691**
**Paper Name: *Big Data Analysis***
**Credits: 3+2**

## Module 1: Introduction to Big Data Analysis
- ● - Overview of big data and its characteristics
- ● - Introduction to Hadoop and MapReduce
- ● - Introduction to Apache Spark

## Module 2: Data Preprocessing and Cleaning
- ● - Data quality assessment and data cleaning techniques
- ● - Handling missing data and outliers
- ● - Feature selection and dimensionality reduction

## Module 3: Data Transformation and Integration
- ● - Data normalization and standardization
- ● - Encoding categorical variables
- ● - Data integration techniques

## Module 4: Exploratory Data Analysis
- ● - Descriptive statistics and data visualization
- ● - Univariate and multivariate analysis
- ● - Outlier detection and handling

## Module 5: Big Data Processing Frameworks
- ● - Introduction to Apache Hadoop ecosystem (HDFS, Hive, Pig)
- ● - Introduction to Apache Spark (RDDs, DataFrames, Spark SQL)

## Module 6: Big Data Processing with Spark
- ● - Data processing with Spark RDDs
- ● - Data processing with Spark DataFrames and Spark SQL
- ● - Introduction to Spark MLlib for machine learning

## Module 7: Machine Learning with Big Data
- ● - Supervised learning techniques for big data
- ● - Unsupervised learning techniques for big data
- ● - Model evaluation and validation

## Module 8: Advanced Topics in Big Data Analysis
- ● - Time series analysis with big data
- ● - Text mining and natural language processing
- ● - Graph analysis and social network analysis

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Module 9: Ethical Considerations in Big Data Analysis**
- ● - Privacy issues and data anonymization
- ● - Bias and fairness in big data analysis
- ● - Ethical frameworks and guidelines

**Module 10: Case Studies and Project**
- ● - Analysis of real-world big data datasets
- ● - Application of big data analysis techniques
- ● - Presentation of project findings

**References**:
1. Pyne, S., & Agrawal, P. (2016). Big Data Analytics: Methods and Applications. CRC Press.
2. White, T. (2015). Hadoop: The Definitive Guide. O'Reilly Media.
3. Zaharia, M., Karau, H., Konwinski, A., & Wendell, P. (2021). Learning Spark: Lightning-Fast Big Data Analysis. O'Reilly Media.

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
Syllabus of *B.Sc. in Data Science*
**Effective from academic session 2023-2024**

**Paper Code: BDS602 & BDS692**
**Paper Name:** *Time Series Analysis*
**Credits: 3+2**

**Module 1: Introduction to Time Series Analysis**
● - Definition of time series
● - Components of a time series
● - Time series data visualization
● - Applications of time series analysis

**Module 2: Descriptive Analysis of Time Series**
● - Measures of central tendency and dispersion
● - Time series plots and patterns
● - Seasonality and trend analysis

**Module 3: Autocorrelation and Partial Autocorrelation**
● - Autocorrelation function (ACF)
● - Partial autocorrelation function (PACF)
● - Identification of autoregressive (AR), moving average (MA), and autoregressive integrated moving average (ARIMA) models

**Module 4: Stationarity and Non-Stationarity**
● - Definition and characteristics of stationarity
● - Unit root tests (e.g., Augmented Dickey-Fuller test)
● - Transformations and differencing for achieving stationarity
● - Trend and seasonality decomposition

**Module 5: Time Series Forecasting**
● - Simple moving average and weighted moving average
● - Exponential smoothing methods (e.g., Holt-Winters method)
● - ARIMA models for forecasting
● - Evaluation and accuracy measures for forecasting models

**Module 6: Time Series Regression**
● - Simple and multiple linear regression models
● - Incorporating lagged variables in regression models
● - Testing and interpreting the regression coefficients
● - Model diagnostics and residuals analysis

**Module 7: Advanced Topics in Time Series Analysis (choose a subset)**
● - ARCH and GARCH models for volatility modeling
● - Vector Autoregressive (VAR) models
● - Seasonal ARIMA models (SARIMA)
● - State-space models and Kalman filtering
● - Spectral analysis and periodogram

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Module 8: Applications of Time Series Analysis**
● - Economic and financial time series analysis
● - Environmental and climate data analysis
● - Engineering and industrial applications
● - Social and health-related time series analysis

**Module 9: Software Tools for Time Series Analysis**
● - Introduction to R or Python programming for time series analysis
● - Hands-on exercises using statistical software packages
● - Implementing forecasting models and analyzing real-world data

**Module 10: Case Studies and Project**
● - Review of case studies from various domains
● - Student projects involving data analysis and modeling
● - Presentation and discussion of project results

**References**:
1. Box, G. E. P., Jenkins, G. M., & Reinsel, G. C. (2008). Time Series Analysis: Forecasting and Control. Wiley-Interscience. ISBN: 978-0470272848.
2. Chatfield, C. (2019). Introduction to Time Series Analysis and Forecasting. Chapman and Hall/CRC. ISBN: 978-0367352090.
3. Pandit, A., & Wu, W. B. (2019). Applied Time Series Analysis. CRC Press. ISBN: 978-0367242483.

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
Syllabus of B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Paper Code: BDS603 & BDS693**
**Paper Name:** *Data Visualization*
**Credits: 2+2**

**Module 1: Introduction to Data Visualization**
- ● - Understanding the importance of data visualization
- ● - Principles and guidelines for effective data visualization
- ● - Overview of data visualization process
- ● - Introduction to data visualization tools

**Module 2: Data Types and Visualization Techniques**
- ● - Types of data and their visual representations
- ● - Categorical data visualization
- ● - Numerical data visualization
- ● - Time-series data visualization
- ● - Geospatial data visualization

**Module 3: Visualization Tools and Technologies**
- ● - Introduction to popular data visualization tools (e.g., Tableau, Power BI, D3.js)
- ● - Exploring features and capabilities of visualization tools
- ● - Hands-on exercises with visualization tools

**Module 4: Data Visualization Design Principles**
- ● - Understanding human perception and cognition in visualization
- ● - Color theory and effective use of colors in visualization
- ● - Designing visually appealing and informative visualizations
- ● - Interaction and user experience design in visualization

**Module 5: Advanced Data Visualization Techniques**
- ● - Multivariate data visualization
- ● - Network visualization
- ● - Hierarchical visualization
- ● - 3D and interactive visualizations

**Module 6: Storytelling with Data Visualization**
- ● - Creating compelling narratives through visualizations
- ● - Techniques for presenting data stories effectively
- ● - Ethical considerations in data visualization
- ● - Case studies and examples of data storytelling

**Module 7: Data Visualization Applications**
- ● - Visualizing data for exploratory analysis
- ● - Visual analytics and decision support systems
- ● - Data visualization for business intelligence
- ● - Data visualization in scientific research

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Module 8: Data Visualization Project**
- - Working on a data visualization project from conception to execution
- - Data collection and preprocessing
- - Designing and implementing visualizations
- - Presenting and documenting the project


**References:**

1. *Data Visualization: Storytelling Using Data* by Sharada Sringeswara; Purvi Tiwari &  U. Dinesh Kumar , Wiley

2. "Storytelling with Data: A Data Visualization Guide for Business Professionals" by Cole Nussbaumer Knaflic

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
Syllabus of *B.Sc. in Data Science*
**Effective from academic session 2023-2024**

**SEMESTER - 7**

**Paper Code: BDS701A**
**Paper Name:** *Research Methodology*
**Credits: 5**

**Module 1: Introduction to Research Methodology**
- ●   - Definition, significance, and characteristics of research
- ●   - Objectives and types of research
- ●   - Research process and steps
- ●   - Research ethics and plagiarism

**Module 2: Formulating Research Questions and Objectives**
- ●   - Identification of research problem
- ●   - Review of literature
- ●   - Research questions and hypotheses
- ●   - Research objectives and significance

**Module 3: Research Design**
- ●   - Experimental, descriptive, and exploratory research designs
- ●   - Longitudinal, cross-sectional, and case study designs
- ●   - Sampling techniques and sample size determination

**Module 4: Data Collection Methods**
- ●   - Primary and secondary data
- ●   - Questionnaire design and administration
- ●   - Interview methods
- ●   - Observation techniques

**Module 5: Data Analysis and Interpretation**
- ●   - Qualitative and quantitative data analysis
- ●   - Descriptive and inferential statistics
- ●   - Statistical software (e.g., SPSS, Excel) for data analysis
- ●   - Interpretation of research findings

**Module 6: Reporting and Presentation of Research**
- ●   - Research report writing
- ●   - Organization and structure of research reports
- ●   - Referencing and citation styles
- ●   - Presentation skills and effective communication of research findings

**Module 7: Research Ethics and Validity**
- ●   - Ethical considerations in research
- ●   - Validity and reliability in research
- ●   - Limitations and challenges in research
- ●   - Strategies for enhancing research validity

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

Paper Code: BDS701B
Paper Name: *Project Management*
Credits: 5

**Module 1: Introduction to Project Management**
- ● - Definition and characteristics of projects
- ● - Importance of project management
- ● - Project life cycle
- ● - Project stakeholders

**Module 2: Project Initiation**
- ● - Project selection and feasibility analysis
- ● - Project charter

**Module 3: Project Scope Management**
- ● - Project scope definition
- ● - Work breakdown structure (WBS)

**Module 4: Project Planning**
- ● - Project objectives and deliverables
- ● - Activity sequencing and network diagrams

**Module 5: Project Scheduling**
- ● - Critical path method (CPM)
- ● - Resource allocation and leveling
- ● - Gantt charts

**Module 6: Project Cost Management**
- ● - Project cost estimation
- ● - Budgeting and cost control

**Module 7: Project Risk Management**
- ● - Identification, analysis, and response planning for project risks
- ● - Risk assessment techniques
- ● - Risk monitoring and control

**Module 8: Project Quality Management**
- ● - Quality planning and assurance
- ● - Quality control and improvement
- ● - Six Sigma and lean principles in project management

**Module 9: Project Procurement Management**
- ● - Make-or-buy decisions
- ● - Contracting and vendor selection
- ● - Contract management and administration

**Module 10: Project Communication Management**
- ● - Communication planning
- ● - Effective communication techniques
- ● - Stakeholder engagement and management

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Module 11: Project Team Management**
- ●       - Team formation and development
- ●       - Team roles and responsibilities
- ●       - Conflict resolution and team motivation

**Module 12: Project Monitoring and Control**
- ●       - Performance measurement and reporting
- ●       - Earned value management (EVM)
- ●       - Change control and configuration management

**Module 13: Project Closure**
- ●       - Project review and lessons learned
- ●       - Project documentation and archiving
- ●       - Project handover and transition

**Module 14: Project Management Software and Tools**
- ●       - Introduction to project management software (e.g., Microsoft Project)
- ●       - Collaborative tools for project teams
- ●       - Project management best practices and emerging trends

**References:**
1.       "Project Management: Planning, Scheduling, and Control" by K. Nagarajan and B. S. Sahay, Tata McGraw-Hill Education, 2014
2.       "Project Management: A Managerial Approach" by R. K. Singh, PHI Learning Pvt. Ltd., 2012

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** *B.Sc. in Data Science*
**Effective from academic session 2023-2024**

**Paper Code: BDS702 & BDS 792**
**Paper Name:** *Deep Learning*
**Credits: 3+2**

**1. Introduction to Deep Learning**
- ●     - Overview of neural networks
- ●     - History and evolution of deep learning
- ●     - Applications of deep learning

**2. Neural Networks Basics**
- ●     - Perceptrons and activation functions
- ●     - Forward propagation and backpropagation
- ●     - Loss functions and optimization algorithms

**3. Feedforward Neural Networks**
- ●     - Architecture and components
- ●     - Training and optimization
- ●     - Regularization techniques

**4. Convolutional Neural Networks (CNNs)**
- ●     - Introduction to CNNs
- ●     - Convolutional and pooling layers
- ●     - Image classification and object detection

**5. Recurrent Neural Networks (RNNs)**
- ●     - Introduction to RNNs
- ●     - Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU)
- ●     - Sequence modeling and language processing

**6. Deep Generative Models**
- ●     - Autoencoders
- ●     - Variational Autoencoders (VAEs)
- ●     - Generative Adversarial Networks (GANs)

**7. Transfer Learning and Fine-Tuning**
- ●     - Pretrained models and feature extraction
- ●     - Fine-tuning for specific tasks
- ●     - Domain adaptation

**8. Deployment and Optimization**
- ●     - Model deployment considerations
- ●     - Quantization and compression
- ●     - Hardware acceleration techniques

**9. Ethical Considerations in Deep Learning**
- ●     - Bias and fairness in AI
- ●     - Privacy and security concerns
- ●     - Ethical guidelines and best practices

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**10. Applications of Deep Learning**
- ●      - Computer vision applications
- ●      - Natural language processing tasks
- ●      - Recommender systems

**References:**
1.      Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
2.      Chollet, F. (2017). *Deep Learning with Python*. Manning Publications.
3.      Buduma, N. (2017). *Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms*.
O'Reilly Media.

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Paper Code: BDS703**
**Paper Name:** *Data Security*
**Credits: 4**

## Module 1: Introduction to Data Security
- Overview of data security concepts and principles
- Importance of data security in various domains
- Legal and ethical considerations

## Module 2: Threats and Vulnerabilities
- Types of threats and attacks on data systems
- Common vulnerabilities and their exploitation
- Risk assessment and management

## Module 3: Cryptography
- Symmetric and asymmetric encryption algorithms
- Hash functions and digital signatures
- Key management and distribution

## Module 4: Network Security
- Secure network architecture and protocols
- Firewalls and intrusion detection/prevention systems
- Virtual private networks (VPNs) and secure remote access

## Module 5: Access Controls
- Identification, authentication, and authorization
- Access control models and mechanisms
- Role-based access control (RBAC)

## Module 6: Secure Coding Practices
- Common software vulnerabilities and attacks
- Secure coding principles and techniques
- Code review and testing for security

## Module 7: Incident Response
- Incident response process and procedures
- Detection and analysis of security incidents
- Incident containment and recovery

## Module 8: Streaming Data Security
- Introduction to streaming data and its unique security challenges
- Security considerations for real-time data processing
- Stream encryption and secure communication protocols

## Module 9: Steganography and Watermarking
- Concealing data within other media for secure communication
- Digital watermarking for data integrity and ownership verification

## Module 10: Data Anonymization and Privacy Preservation
- Techniques for anonymizing sensitive data

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

- Privacy-preserving algorithms and protocols

**Module 11: Cloud Security**
- Security considerations for cloud-based data storage and processing
- Cloud security controls and best practices

**Module 12: Mobile Device Security**
- Security challenges in mobile device environments
- Mobile device encryption and secure application development

**Module 13: Internet of Things (IoT) Security**
- Security challenges in IoT ecosystems
- Securing IoT devices and communication channels

**References:**
1.      "Data and Application Security: Developments and Directions" by Sushil Jajodia and Vijayalakshmi Atluri, Springer, Published in 2011
2.      "A Comparative Study of Cryptographic Algorithms for Data Security" by D Samanta and N Dey, International Journal of Computer Applications, 2014
3.      "Streaming Data Security: Challenges and Solutions" by D Garg, G Sharma, and V Singh, International Conference on Inventive Systems and Control (ICISC) 2017

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
Syllabus of *B.Sc. in Data Science*
**Effective from academic session 2023-2024**

**SEMESTER - 8**

**Paper Code: BDS801**
**Paper Name:** *IOT & Sensor Data Analysis*
**Credits: 5**

**Module 1: Introduction to IoT and Sensor Data Analysis**
- Introduction to the Internet of Things (IoT) and its applications
- Overview of sensor technologies and their role in IoT
- Understanding data collection and communication in IoT systems
- Introduction to sensor data analysis and its importance

**Module 2: Sensor Technologies and Data Acquisition**
- Overview of different types of sensors used in IoT systems
- Principles of data acquisition from sensors
- Techniques for sensor data preprocessing and cleaning
- Hands-on exercises on sensor data acquisition using popular IoT platforms or development boards

**Module 3: Data Storage and Management for IoT**
- Introduction to data storage options for IoT applications
- Database management systems for sensor data storage
- Data retrieval and querying techniques for sensor data
- Exploring cloud-based storage and IoT platforms for data management

**Module 4: Sensor Data Processing and Analytics**
- Techniques for processing and analyzing sensor data
- Exploring statistical methods for sensor data analysis
- Introduction to machine learning algorithms for sensor data analysis
- Hands-on exercises on sensor data processing and analytics using Python libraries

**Module 5: Visualization and Reporting of Sensor Data**
- Importance of data visualization in IoT and sensor data analysis
- Overview of visualization techniques and tools for sensor data
- Creating interactive dashboards for sensor data monitoring
- Generating reports and insights from sensor data analysis results

**Module 6: Security and Privacy in IoT and Sensor Data Analysis**
- Understanding security challenges in IoT systems
- Techniques for securing sensor data transmission and storage
- Privacy considerations in sensor data analysis
- Introduction to encryption and authentication methods for IoT systems

**Module 7: Real-world Applications and Case Studies**
- Exploring real-world applications of IoT and sensor data analysis
- Case studies on smart cities, industrial IoT, healthcare, etc.
- Understanding the challenges and opportunities in implementing IoT systems
- Guest lectures from industry experts sharing their experiences and insights

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Module 8: Project Work**

- Students work on a semester-long project related to IoT and sensor data analysis
- Project includes data acquisition, preprocessing, analysis, and visualization
- Regular project reviews and guidance from the instructor
- Final project presentation and documentation

**References:**

1.      *Introduction to IoT* by Sudip Misra, Anandarup Mukherjee and Arijit Roy; Cambridge University Press.
2.      *Internet of Things* by Jeeva Jose, Khanna Publishing House

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

**Paper Code: BDS802**
**Paper Name:** *Social Network Analysis*
**Credits: 5**

## Module 1: Introduction to Social Network Analysis
- What is social network analysis?
- Basic concepts: nodes, ties, networks, and graphs
- Historical development of social network analysis
- Different types of social networks
- Software tools for network analysis

## Module 2: Social Network Data Collection and Representation
- Methods for collecting social network data (surveys, interviews, observation)
- Types of network data: ego-centric vs. whole network
- Data representation: adjacency matrices, edge lists, and node attribute files
- Visualization of networks

## Module 3: Measures of Centrality and Prestige
- Degree centrality
- Betweenness centrality
- Closeness centrality
- Eigenvector centrality
- Prestige centrality

## Module 4: Structural Holes and Brokerage
- Structural holes theory
- Brokerage and structural equivalence
- Closure and structural cohesion
- The strength of weak ties

## Module 5: Subgroups and Clustering in Networks
- Clustering coefficient
- Triadic closure
- Community detection algorithms (e.g., modularity, hierarchical clustering)
- Role analysis and structural equivalence

## Module 6: Diffusion and Contagion in Networks
- Diffusion processes in networks
- The spread of information and innovations
- Contagion models (e.g., epidemic models, influence maximization)
- Network cascades and tipping points

## Module 7: Social Influence and Opinion Dynamics
- Social influence models (e.g., social learning, social comparison)
- Opinion dynamics models (e.g., bounded confidence, compromise)
- Polarization and echo chambers

**Maulana Abul Kalam Azad University of Technology, West Bengal**
**(Formerly known as West Bengal University of Technology)**
**Syllabus of** B.Sc. in Data Science
**Effective from academic session 2023-2024**

- Computational modeling of social influence

**Module 8: Network Visualization and Analysis Tools**
- Network visualization techniques (e.g., node-link diagrams, matrix plots)
- Introduction to network analysis software (e.g., Gephi, NetworkX, R packages)
- Hands-on exercises and projects using network analysis tools

**Module 9: Advanced Topics in Social Network Analysis**
- Multiplex networks and multidimensional networks
- Longitudinal network analysis
- Dynamic network models
- Big data and online social networks
- Ethical considerations in social network analysis

**Module 10: Applications of Social Network Analysis**
- Organizational networks and collaboration
- Social network analysis in healthcare
- Political networks and opinion formation
- Online social networks and social media analysis
- Crime and terrorism networks

**References:**
1.      Scott, J. (2017). Social network analysis (4th ed.). SAGE Publications.
2.      Wasserman, S., & Faust, K. (1994). Social network analysis: Methods and applications. Cambridge University Press.
3.      Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2018). Analyzing social networks. SAGE Publications.

**Note: Honors with Research track shall be notified in advance along with the evaluation rubric for Capstone/ Research project, 12 credits, Sessional.**