MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
MBA in Business Analytics (In-House Programme)
(Effective from academic session 2020-21)

FOURTH SEMESTER

MBA(BA) 401	BIG DATA TECHNOLOGY
MBA(BA) 402	DATA MODELING
MBA(BA) 403	DATA MINING
MBA(BA) 404	PREDICTIVE ANALYTICS
MBA(BA) 405	DATA ANALYTICS USING PYTHON
MBA(BA) 406	OPTIMIZATION ANALYTICS

Detailed Syllabus

MBA(BA) 401: DATA MODELING

MODULE I:

1. **Data Modeling Concepts:** Definition, Requirements of data modeling, Different data modeling tools, Other alternatives title of a data modeler, Role and responsibilities of a data modeler, IDEF1X and IE methodology. [3L]
2. **Data Modeling Types and Standard:** Logical, physical, dimensional, conceptual and enterprise data model, Data modeling development life cycle, Naming standards of objects, Abbreviating column names, Consistency in column names and importance. [3L]
3. **Data Warehouse and OLAP:** Data Warehouse and DBMS, Multidimensional data model, OLAP operations. [2L]
4. **Database Explanation from Data Modeling Perspective:** Main object (Table, Column, Data Type), Constraints (NULL, NOT NULL, Primary Key, Unique, Check and Default Value), Other Objects (Database, Schema, Tablespace, Segment, Extent, Privileges, Index, View, Synonym), DDL and DML statements. [6L]
5. **Creating Logical Data Model:** Entity, Attribute, Primary and alternative key, Inversion key entry, Rule, Relationship, Definition, Index, Unique index. [4L]

MODULE II:

6. **Relationships:** Identifying, non-identifying and many to many, Cardinality, Different types of relationships (One to one, one to many, many to one and many to many relationships), Self-referential integrity relationship, Normalization process (1NF, 2NF, 3NF), Supertypes and subtypes. [4L]
7. **Creating a Physical Data Model:** Table, Column, Different key constraints, Default value, Unique and non-unique index, Difference between a logical and physical data model. [4L]
8. **Physical Data Model, Database and Scripts:** Forward and Reverse Engineering, Generating scripts from a data model, comparing database and data model, Implementing physical data model in a database, Generating SQL code and implementing on a database. [6L]

9. **Repository, Meta data and Maintenance of the data model:** Repository, Meta data, Maintaining of the data model and work in a multi-user environment, Dimensional data modeling (Causal, Junk, Outrigger, Degenerate). [8L]

Suggested Readings:

1. Patterns of Data Modeling by Michael R. Blaha.
2. The Enterprise Data Model: A framework for enterprise data architecture, 2nd edition by Andy Graham.
3. Data Modeling Theory and Practice by Graeme Simsion.
4. The Data Model Resource Book: Volume 3: Universal Patterns for Data Modeling by Len Silverston.
5. Data Modeling Essentials by Graeme Simsion, Graham Witt**,** Morgan Kaufmann Publishers.
6. Beginning Relational Data Modeling by Sharon Allen, Apress.

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MBA(BA) 402: BIG DATA TECHNOLOGY

MODULE I:

1. **Overview of Big Data:** History of big data, elements of big data, career related knowledge in big data, advantages, disadvantages, structured and unstructured data. [6L]
2. **Using Big Data in Businesses:** Use of Big Data in Marketing, Finance, HR, Production and Supply Chain Management. [8L]
3. **Technologies for Handling Big Data:** Introduction to Hadoop, functioning of Hadoop, Cloud computing (features, advantages, applications), Application Data store (NOSQL, OLAP. [6L]

MODULE II:

4. **Understanding Hadoop Ecosystem:** Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Meta store, Comparison with Traditional Databases, Hive QL, Tables, Querying Data and User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbase versus RDBMS. Big SQL: Introduction. [8L]
5. **Hadoop Distributed File System:** The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume, Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures. [6L]
6. **NoSQL Data Management:** NoSQL including document databases, Graph Database, Schema less database, CAP Theorem. [4L]
7. **Case Studies.** [2L]

Suggested Readings:

1. Zomaya and Sakr: Handbook of Big Data Technology.
2. Sumit Gupta: Real time Big Data Analytics Book.
3. E. Siegel: Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die.
4. A. Maheshwari: Data Analytics Made Accessible.
5. J. W. Foreman: Data Smart: Using Data Science to Transform Information into Insight.
6. V. Mayer-Schönberger and K. Cukier: Big Data: A Revolution That Will Transform How We Live, Work, and Think.

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MBA(BA) 403: PREDICTIVE ANALYTICS

MODULE I:

1. **Probability and Analysis of Variance:** Law of total probability, Conditional probability, Bayes' theorem and applications. Discrete and continuous random variable, Testing equality of population means (One–Way & Two–Way Classification). [8L]
2. **Multiple Correlation Analysis:** Introduction, Significance of multiple correlation, Multiple and partial correlation, Relation between multiple and partial correlation coefficients. [4L]
3. **Multiple Regression Analysis:** Introduction, Significance of Multiple Regression Analysis, Estimating the parameters of Multiple Regression by method of Least Squares and Using Regression Coefficient methods, Relation between partial regression coefficients and correlation coefficients, Standard Error of Estimates for Multiple regression. [6L]

MODULE II:

4. **Measures of Central Tendency:** Measures of dispersion, Range, Quartile deviation, Mean deviation, Standard deviation, Coefficient of variation, Moments, Absolute moments, Factorial moments, Skewness, Kurtosis, Sheppard's corrections. [6L]
5. **Forecasting Trend:** Introduction, Linear trend model, Exponential trend, Measurement of Seasonal effects – Method of Simple Average, Ratio-to-Trend Method, Ratio-to-Moving Average Method, Link Relative Method. [4L]
6. **Hypothesis testing:** Estimation and sampling techniques, Sample mean, Sample variance, t, Chi-square and F tests of significance based on them, Small sample tests. [10L]
7. **Case Studies.** [2L]

Suggested Readings:

1. Srivatsava TN, Shailaja Rego: Statistics for Management, Tata McGraw Hill.
2. Anand Sharma, Statistics for Management, Himalaya Publishing House.
3. Amir D.Aczel, Jayavel Sounderpandian (2015), Complete Business Statistics, New Delhi:Tata McGrawHill.
4. S.P. Gupta &M.P. Gupta (2015), Business Statistics, New Delhi: Sultan Chand & Sons.
5. Goon-Gupta-Dasgupta: Outline of Statistics 1 and 2, The World Press.
6. Gupta and Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

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MBA(BA) 404: DATA MINING & VISUALIZATION

MODULE I:

1. **Introduction to Data Mining:** Data mining, Related technologies – Machine Learning, DBMS, OLAP, Statistics, Data Mining Goals, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications. [4L]
2. **Data Preprocessing:** Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Installing Weka 3 Data Mining System. [4L]
3. **Data Mining Knowledge Representation:** Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge. Visualization techniques. [4L]
4. **Data Visualization Softwares:** Experiments with Weka- visualization, Tableau, Microsoft Power BI. [5L]
5. **Attribute-Oriented Analysis:** Attribute generalization, Attribute relevance, Class comparison, Statistical measures, Model Performance Measures. [4L]

MODULE II:

6. **Data Mining Algorithms I:** Association rules, Motivation and terminology, Generating item sets and rules efficiently, Correlation analysis. [4L]
7. **Data Mining Algorithms II:** Classification, Basic learning/mining tasks, Inferring rudimentary rules: 1R algorithm, Decision trees (CHAID), Random Forest, Covering rules. [6L]
8. **Data Mining Algorithms III:** Prediction, The prediction task, Bayesian classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear Models. [4L]
9. **Clustering:** Basic issues in clustering, conceptual clustering system, Partitioning methods: k-means, expectation maximization (EM), Hierarchical methods: distance based agglomerative and divisible clustering, Conceptual clustering: Cobweb. [5L]

Suggested Readings:

1. Hand D., Mannila H. and Smyth P.: Principles of Data Mining, MIT Press, 2001.
2. Langley P.: Elements of machine learning, Morgan Kaufmann Publishers, 1996.
3. Larose D.T.: Discovering knowledge in data: an introduction to data mining, Wiley-Interscience, 2005.
4. Witten, I.H., Frank, E., Hall, M.A., Pal, C.J.,: Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann Publishers, 2016.
5. Powell B.: Mastering Microsoft Power BI: Expert techniques for effective data analytics and business intelligence, Packt (Paperback), 2018.
6. Zhang, J.: Tableau 10.0 Best Practices, Packt (Paperback), 2016.

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MBA(BA) 405: DATA ANALYTICS USING PYTHON

MODULE I:

1. **Python Basics:** Python variables, expressions, statements Variables, Keywords, Operators & operands, Expressions, Statements, Order of operations, String operations, Comments, Keyboard input. [4L]
2. **Conditions & Iterations:** Conditions, Modulus operator, Boolean expression, Logical operators, if, if else, if-elif-else, Nested conditions, Iteration - while, for, break, continue, Nested loop. [4L]
3. **Functions:** Type conversion function, Math functions, Composition of functions, defining own function, parameters, arguments, Importing functions. [4L]
4. **Recursion:** Python recursion, Examples of recursive functions, Recursion error, Advantages & disadvantages of recursion.

Strings: Strings Accessing values in string, Updating strings, Slicing strings, String methods – upper(), find(), lower(), capitalize(), count(), join(), len(), isalnum(), isalpha(), isdigit(), islower(), isnumeric(), isspace(), isupper() max(), min(), replace(), split().

List: Introduction, Traversal, operations, Slice, Methods, Delete element, Difference between lists and strings, Example program, Dictionaries - idea of dictionaries.

Tuples: Idea of lists & tuples, Brief idea of dictionaries & tuples. [8L]

MODULE II:

5. **Object-Oriented Programming with Python:** Concepts, Creating class, Instance objects, Accessing attributes, built in class attributes, destroying objects, Inheritance, Overloading, Overriding, Data hiding. [4L]
6. **Python Exceptions:** Exception handling, except clause, User Defined Exceptions Regular expression- Match function, Search function, Matching VS Searching, Modifiers, Patterns. [4L]
7. **File Operations in Python:** create, open, read, write, append, close files; Stack and Queue, Stacks and Queues using lists. [4L]
8. **NumPy, SciPy, SymPy:** basic concepts.

Pandas: Object creation, Viewing data, Selection, Missing data, Operations, Merge, Grouping, Reshaping, Time series, Categoricals, Plotting, Getting data in/out from CSV, Excel. [6L]

9. **Case Studies.** [2L]

Suggested Readings:

1. Python Programming by Anurag Gupta, G Biswas – Mcgraw Hill Education.
2. Learn Python The Hard Way by Zed A. Shaw, ADDISON-WESLEY.
3. Learning Python by Mark Lutz, O'REILY.
4. Programming In Python by Dr. Pooja Sharma, BPB.
5. Python Programming - Using Problem Solving Approach by Reema Thareja, OUP.
6. Fundamentals of Python by Kenneth A Lambert, New Delhi: Cengage Learning.

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MBA(BA) 406: Optimization Analytics

MODULE I:

1. **Linear programming:** Managerial Applications of Optimization & Limitations, Formulation of LP models, Formulation of LP models, Formulating maximization/minimization problems, Graphical solution, simplex methods, Special cases of LP, Duality of LP and its interpretation, Dual simplex methods, Post Optimality/sensitivity analysis, Applications of LP. [10L]
2. **Markov Analysis:** Brand switching analysis, Prediction of market shares for future periods, Equilibrium conditions, Uses of Markov analysis. [6L]
3. **Transportation & Assignment Problems:** VAM method, checking for optimally using MODI method, unbalanced problem and degeneracy, Hungarian method for assignment problem, Traveling salesman problem. [4L]

MODULE II:

4. **Game Theory:** Concept of saddle point, Pure & Mixed Strategy, Graphical Method, Dominance Property. [4L]
5. **Replacement Models and Sensitivity Analysis:** Types of replacement problems, Replacement of assets that deteriorate with time, Understanding of sensitivity model and observe the behavior, Measurement of sensitivity analysis, Methods of sensitivity analysis, Using sensitivity analysis for decision making. [6L]
6. **Network Analysis:** PERT & CPM – Project scheduling by PERT/CPM – Cost considerations in PERT/CPM. [8L]
7. **Case Studies.** [2L]

Suggested Readings:

1. J. K. Sharma, "Operations Research Theory and Application", Macmillan Publishers, 4th Ed, 2009.
2. Hamdy A Taha, "Operations Research", Pearson. 9th Ed, 2010.
3. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International Pvt. Ltd., New Delhi, 2000.
4. G.V. Shenoy, U.K. Srivastava, S.C. Sharma, "Operations Research for Management", New Age International, Revised 2nd Ed, 2005.
5. Edwin K. P. Chong, Stanislaw H. Zak, "An Introduction to Optimization", Wiley, 2001.
6. Xin□She Yang, "Optimization Techniques and Applications with Examples," Wiley, 2018.