

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WB
(Formerly West Bengal University of Technology)
Syllabus for B.Sc.in Data Science (Industry Induced)
(Effective for Students Admitted in Academic Session 2019-2020)
SEMESTER-II

Paper: Mathematics for Data Scientists-II

Code: DSI-201

Contacts Hours / Week: 3L + 1T

Credits: 4

Module-1: Introduction to Matrices and Determinants; Solution of Linear Equations; Cramer's rule; Inverse of a Matrix. (8L)

Module-2: Vectors and linear combinations; Rank of a matrix; Gaussian elimination; LU Decomposition; Solving Systems of Linear Equations using the tools of Matrices. (10L)

Module-3: Vector space; Dimension; Basis; Orthogonality; Projections; Gram-Schmidt orthogonalization and QR decomposition. (8L)

Module-4: Eigenvalues and Eigenvectors; Positive definite matrices; Linear transformations; Hermitian and unitary matrices; (8L)

Module-5: Singular value decomposition and Principal component analysis; (6L)

Text Books:

1. B. S. Grewal.-*Higher Engineering Mathematics*
2. Chandrika Prasad & Reena Garg – *Advanced Engineering Mathematics*

Reference Books:

1. *Peter V. O'Neil.-Advanced Engineering Mathematics, 7th Edition*
2. *Michael. D. Greenberg -Advanced Engineering Mathematics, 2nd Edition*
3. *Gilbert Strang -Introduction to linear algebra, 5th Edition*
4. *P. N. Wartikar& J. N. Wartikar -Applied Mathematics (Vol. I & II)*
5. *R C Gonzalez and R E Woods -Digital Image Processing*

Paper: Data Structures and Algorithms

Code: DSI-202

Contacts Hours / Week: 3L

Credits: 3

Module-1: Basic Terminologies & Introduction to Algorithm and Data Organisation:

Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction (4L)

Module-2: Linear Data Structure: Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures (10L)

Module-3: Non-linear Data Structure: Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree) and Graphs (Directed, Undirected), Various Representations, Operations (search and traversal algorithms and complexity analysis) & Applications of Non-Linear Data Structures (12L)

Module-4: Searching and Sorting on Various Data Structures: Sequential Search, Binary Search, Breadth First Search, Depth First Search, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap Sort, Introduction to Hashing (10L)

Module-5: File: Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes. (4L)

Paper: Data Structures and Algorithms

Code: DSI-291

Contacts Hours / Week: 2P

Credits: 1

Laboratory

1. Towers of Hanoi using user defined stacks.
2. Reading, writing, and addition of polynomials.
3. Line editors with line count, word count showing on the screen.
4. Trees with all operations.
5. All graph algorithms.
6. Saving / retrieving non-linear data structure in/from a file

Text Books:

1. E. Horowitz and S. Sahni, Fundamentals of Data Structures, 1977.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms
3. R.S. Salaria, Data Structures and Algorithms using C, Khanna Publishing House, 2018

Reference Books:

1. Donald E. Knuth-The Art of Computer Programming: Volume 1: Fundamental Algorithms
2. Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein-Introduction to Algorithms
3. Pat Morin-Open Data Structures: An Introduction (Open Paths to Enriched Learning), 31st ed. Edition
4. R.B. Patel, Expert Data Structures With C, Khanna Publishing House, 2018

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Paper: Environmental Science
Code: DSI(HU)-203
Contacts Hours / Week: 3L + 1T
Credits: 4

Module-1: Definition, Principles and scope of Environmental Science. Earth, Man and Environment. Ecosystems, Mass and Energy transfer across the various interfaces, material balance. First and Second law of thermodynamics, heat transfer processes. Scale of Meteorology, pressure, temperature, precipitation, humidity, radiation and wind. Atmospheric stability, inversions and mixing height, wind roses. Natural resources, conservation and sustainable development. (4L)

Module-2: Fundamentals of Environmental Chemistry, Chemical composition of Air : Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry. Chemistry of air pollutants, Photochemical smog. Water Chemistry, Principles of Analytical Methods : Titrimetry, Gravimetry, Colourimetry, Spectrophotometry. Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometry, GLC, HPLC, Electrophoresis, X-ray fluorescence, X-ray diffraction, Flame photometry. (5L)

Module-3: Definition, Principles and scope of ecology, Human ecology and Human settlement, Evolution, Origin of life and speciation. Ecosystem, Common flora and fauna in India Aquatic Microflora of Atmosphere : Air Sampling techniques, Identification of aeroallergens. Air-borne diseases and allergies. Environmental Biotechnology : Fermentation Technology, Vermiculture technology, Biofertilizer technology. (5L)

Module-4:

Environmental Geosciences, Earth's Processes and Geological Hazards, Mineral Resources and Environment : Resources and Reserves, Minerals and Population. Oceans as new areas for exploration of mineral resources. Ocean ore and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals. Water Resources and Environment, Resources of oceans. Ocean pollution by toxic wastes. Human use of surface and groundwaters. Groundwater pollution. Landuse Planning, Environmental Geochemistry, Biogeochemical factors in environmental health. Human use, trace elements and health. Possible effects of imbalance of some trace elements. Diseases induced by human use of land. Principles of Remote sensing and its application of Environmental Sciences. Application of GIS in Environmental Management. (6L)

Module-5:

Sun as source of energy; solar radiation and its spectral characteristics; Fossil fuels—classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas. Principles of generation of hydroelectric power, nuclear energy—fission and fusion; magnetohydrodynamic power, bio-energy—energy from biomass and biogas, anaerobic digestion; energy use pattern in different parts of the world. Environmental implication of energy use; impacts of large-scale exploitation of Solar, Wind, Hydro and Ocean energy (3L)

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Module-6:

Air : Natural and anthropogenic sources of pollution. Acid Rain, Air Quality Standards. Water : Types, sources and consequences of water pollution. Physico-chemical and Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard. Soil, Soil Pollution Control. Industrial waste effluents and heavy metals, Noise : Sources of noise pollution, measurements of noise and Indices. Marine : Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system–coastal management. Radioactive and Thermal Pollution. (4L)

Module-7:

Introduction to environmental impact analysis, Environmental impact Statement and Environmental Management Plan. EIA guidelines 1994, Notification of Government of India. Impact Assessment Methodologies. Generalized approach to impact analysis. Procedure for reviewing Environmental impact analysis and statement. Guidelines for Environmental audit. Introduction of Environmental planning. Base line information and predictions (land, water, atmosphere, energy, etc.) Restoration and rehabilitation technologies. Landuse policy for India. Urban planning for India. Rural planning and landuse pattern. Concept and strategies of sustainable development. Cost-Benefit analysis. Environmental priorities in India and sustainable development. (3L)

Module-8:

Sources and generation of solid wastes, their characterization, Hazardous Waste Management and Handling Rules, 1989, Resource Management, Disaster Management and Risk analysis. Environment protection–issues and problems, International and National efforts for Environment Protection, Provision of Constitution of India regarding Environment (Article 48A and 58A) Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control, Wildlife Protection Act, Forest Conservation Act, Indian Forests Act (Revised) 1982, Air (Prevention and Control of Pollution) Act, Motor Vehicle Act. 1988, The Water (Prevention and Control of Pollution) Act, 1974, Public Liability Insurance Act, 1991 and Rules 1991. (3L)

Module-9:

Basic elements and tools of statistical analysis; Probability, sampling, measurement and distribution of attributes; Distribution– Normal, t and χ^2 , Poisson and Binomial; Arithmetic, Geometric and Harmonic means; Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting. Models of population growth and interactions–Lotka-Volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model. (3L)

Module-10:

Environmental Education and Awareness. Environmental Ethics and Global imperatives. Context : Narmada Dam, Tehri Dam, Almetti Dam, Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil. Waste lands and their reclamation, Vehicular pollution and urban air quality. Depletion of Nature resources. Biodiversity conservation and Agenda-21. Waste disposal, recycling and power generation, Fly ash utilization. Rain water harvesting. Wet lands conservation. Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic) (4L)

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Text Books:

1. Enger, E. and Smith, B., Environmental Science: A Study of Interrelationships, Publisher: McGraw-Hill Higher Education; 12th edition, 2010.
2. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
3. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House
4. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House

Reference Books:

1. Richard T Wright, Environmental Science: Towards a Sustainable Future, Prentice-Hall Inc., 2008.
2. S.C. Sharma, Environmental Engineering, Khanna Publishing House

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Paper: Computational Statistics-II

Code: DSI-204

Contacts Hours / Week: 3L

Credits: 3

Module-1: Linear Statistical Models: Simple linear regression & correlation, multiple regression & multiple correlation, Analysis of variance (6L)

Module-2: Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation. (8L)

Module-3: Sufficient Statistic: Concept & examples, complete sufficiency, their application in estimation (5L)

Module-4: Test of hypothesis: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing (6L)

Module-5: Non-parametric Inference: Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test. Tolerance region (10L)

Module-6: Basics of Time Series Analysis & Forecasting: Stationary, ARIMA Models: Identification, Estimation and Forecasting. (5L)

Text Books:

1. I.R. Miller, J.E. Freund and R. Johnson. *Probability and Statistics for Engineers* (4th Edition)
2. A. Goon, M. Gupta and B.Dasgupta. *Fundamentals of Statistics* (Vol. I & Vol. II)
3. Chris Chatfield. *The Analysis of Time Series: An Introduction*

Reference Books:

1. D.C. Montgomery & E.Peck- *Introduction to Linear Regression Analysis*
2. A.M. Mood, F.A. Graybill& D.C. Boes. *Introduction to the Theory of Statistics*
3. N. Draper & H. Smith- *Applied Regression Analysis*
4. Garrett Grolemond- *Hands-on Programming with R*
5. Jared P. Lander- *R for Everyone: Advanced Analytics and Graphics*
6. Jeeva Jose – *Beginner's Guide for Data Analysis using R Programming*

Paper: Computational Statistics-II Lab

Code: DSI-292

Contacts Hours / Week: 2P

Credits: 1

Laboratory:

R statistical programming language: Introduction to R, Functions, Control flow and Loops, Working with Vectors and Matrices, Reading in Data, Writing Data, Working with Data, Manipulating Data, Simulation, Linear model, Data Frame, Graphics in R

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Paper: Management Concepts & Marketing Research

Code: DSI-205

Contacts Hours / Week: 3L + 1T

Credits: 4

Module-1: Introduction to Marketing, Defining Marketing Core concepts in Marketing Evolution of Marketing o Marketing Planning Process Contemporary Issues and Practices (6L)

Module-2: Scanning the Business Environment The value chain, Core Competencies Strategic Planning Process, PESTEL Competition Analysis SWOT Analysis (6L)

Module-3: Marketing Information System and Marketing Research Role of Marketing Information System in Managerial Decision Making Process Components of Marketing Information systems, The Marketing Research Process: An overview Defining the Management Decision Problem and Marketing Research Problem Framing Research Objectives and developing the research plan Exploratory vs. Conclusive Research (10L)

Module-4: Buyer Behavior Consumer Behavior Consumer buying process model What Influences Consumer Behavior Key Psychological Processes The Buying Decision Process: The Five Stage Model Other Theories of Consumer Decision Making Industrial Buyer Behavior Concept of Buying Center Industrial buying process model Influence of Economic and Behavioral Factors Influence of Procurement Organization Role of Negotiation Process (12L)

Module-5: Generic Marketing strategies; Defining market segmentation; Bases of segmentation; Evaluation of targeting market segments; Brand positioning and differentiation (6L)

Text Books:

1. K. H. Erickson, *Marketing Management Concepts and Tools: A Simple Introduction*
2. Malhotra, *Dash-Marketing Research*,

Reference Books:

1. Scott Smith and Gerald Albaum , *Fundamentals in Marketing Research*
2. Mark Saunders, Philip Lewis and Adrian Thornhill-*Research Methods for Business Students*,