SHRI MATA VAISHNO DEVI UNIVERSITY
SUB POST OFFICE – 182320, J & K
Faculty of Sciences
School of Mathematics

No. SMVDU/SoM/25/374
Dt. 01-08-2025

MINUTES OF THE 14TH MEETING OF BOARD OF STUDIES OF SCHOOL OF MATHEMATICS, HELD ON 31ST OF JULY, 2025 IN ROOM NO. D-207

During the meeting following were present:

S. No.	Name / BoS Participants	Affiliation
1.	Dr. Kuldip Raj	Head, SoM and Chairman, BoS.
2.	Prof. Sartaz Ul Hasan	Professor, Department of Mathematics, IIT, Jammu
3.	Prof. Ajay Sharma	Professor, Department of Mathematics, Central University, Jammu
4.	Prof. V. K. Bhat	Professor, School of Mathematics (SoM)
5.	Prof. A. K. Das	Professor, SoM
6.	Dr. Rakesh Kumar	Associate Professor, SoM
7.	Dr. Abhishek Singh	Associate Professor, SoM
8.	Dr. Sandeep Bhougal	Assistant Professor & Member Secretary of BoS, SoM
9.	Dr. Sandeep Sharma	Assistant Professor, SoM
10.	Dr. Sunny Kr. Sharma	Assistant Professor, SoM
11.	Dr. Vivek Kumar	Assistant Professor, SoM
12.	Dr. Sunil Kr. Sharma	Assistant Professor, SoM

Welcome and Introduction

The Chairman of the Board introduced all faculty members of the school to the member experts. He welcomed all the members to the 14th meeting of Board of Studies and thanked Prof. Ajay Sharma (In person) & Prof. Sartaz Ul Hasan (Online) for attending the Board of Studies in spite of their busy schedule.

The agenda of BoS meeting is to consider the item-wise deliberations, as per the following detail

Item:14.1	**To confirm the minutes of the 13th meeting of Board of Studies (BoS), held on 5th of February, 2025.** ***(As no further comments/suggestions received from the members, the house may approve the minutes of last meeting of BoS.)***
Item:14.2	**To discuss / review the programme structure of new course structure of the M.Sc. Data Science Programme. [Entry Batch 2025].** ***(The same is Annexed as Annexure-I)*** **Thorough discussions were held on the proposed programs, with valuable input and insights provided by the external experts. The course structure of the said programme was discussed, approved and recommended to be included in the next meeting of Academic Council.**
Item:14.3	**To discuss / review the new AEC course for existing B. Tech (All Streams).** ***(The same is Annexed as Annexure-II)*** **Suggestions from external experts were incorporated in the new AEC course, Fundamentals of Integral Transforms and Complex Analysis (MTLAE 104) which was discussed, approved and recommended to be included in the next meeting of Academic Council.**
Item:14.3	**To discuss / review the programme structure and syllabus of existing FYUP (2024).** ***(The same is Annexed as Annexure-III)*** **Thorough discussions were held on the proposed agenda of course Queuing Theory (MTLMI304) as MINOR/DSC-4 to be shifted to MINOR/DSE-10 because it is a specialized course and should be offered to Masters level students. Also, Fuzzy Logic and Applications course was shifted from Major course to Elective course (MTLMI 307) and Metric Spaces was introduced as Major course (MTLMD 305).**
Item:14.5	**Any other item with the permission of chair**

The Meeting ended with a vote of thanks to the Chair.

01.08.2025

Dr. Sandeep Bhougal
(Member Secretary, BoS)

Dr. Kuldip Raj
(Chairman, BoS)

HoD Mathematics <hod.math@smvdu.ac.in>

Minutes of the 14th BoS of School of Mathematics.

3 messages

HoD Mathematics <hod.math@smvdu.ac.in> Fri, Aug 1, 2025 at 12:34 PM
To: ajay sharma <aksju76@gmail.com>, Sartaj Ul Hasan <sartaj.hasan@iitjammu.ac.in>

Dear Sir,
Kindly find attached herewith the minutes of the 14th BoS of School of Mathematics for your kind approval and suggestions(if any).

--
Head,
School of Mathematics
Shri Mata Vaishno Devi University
Katra-182320, (J&K), India

MOM BOS-14 2025.doc
511K

Sartaj Ul Hasan <sartaj.hasan@iitjammu.ac.in> Fri, Aug 1, 2025 at 1:05 PM
To: HoD Mathematics <hod.math@smvdu.ac.in>
Cc: ajay sharma <aksju76@gmail.com>

Dear Sir,

I hereby approve the attached minutes.

Regards,
Sartaj Ul Hasan

[Quoted text hidden]

ajay sharma <aksju76@gmail.com> Fri, Aug 1, 2025 at 1:36 PM
To: Sartaj Ul Hasan <sartaj.hasan@iitjammu.ac.in>
Cc: HoD Mathematics <hod.math@smvdu.ac.in>

Dear Sir,

I have reviewed the minutes of the 14th Board of Studies meeting of the School of Mathematics and found everything in order. I approve the minutes as presented and have no further suggestions.

With best regards,

Ajay K. Sharma

[Quoted text hidden]

Annexure-I

Course Structure of the M.Sc. Data Science Programme

[Entry Batch 2025]

SMVDU PG Structure 2 (Level 6.5) **NEP- Coursework with Research**

Semester – I

Course Code	Course Name	Type of Course	L-T-P	Credits
DAS MDXXX	Data Structure & Algorithm Design	DSC-6	3-0-0	3
DAS MDXXX	Data Structure & Algorithm Design Lab	DSC-6	0-0-2	1
DAS MDXXX	Statistics and Probability for Analytics	DSC-2	3-0-0	3
DAS MDXXX	Statistics and Probability for Analytics Lab	DSC-2	0-0-2	1
DAS MDXXX	Research Methodology	DSC-3	3-0-0	3
DAS MDXXX	Mathematics Essential	Bridge Course	NC	
DAS MDXXX	Introduction to Linux and Database technologies	CCC	2-0-2	3
DAS MDXXX	Elective	DSE-1	2-0-4	4
DAS MDXXX	Elective	DSE-2	2-0-4	4

Total Credit=22

Semester – I (Bridge Course, 3 Lecture per week, Non-Credit course)
Mathematics Essential is going to be compulsory for students who have no exposure to mathematics in graduation or intermediate.

Semester – I (Electives)
Students can choose any two electives from the list.

1. Programming in R
2. Programming in Python
3. Big Data Tools &Technologies-I

CCC* Common compulsory course

Semester – II

Course Code	Course Name	Type of Course	L-T-P	Credit
DAS MDXXX	Machine Learning	DSC-1	3-0-0	3
DAS MDXXX	Machine Learning Lab	DSC-1	0-0-2	1
DAS MDXXX	Regression Theory & Analysis	DSC-5	3-0-0	3
DAS MDXXX	Regression Theory & Analysis Lab	DSC-5	0-0-2	1

DAS MDXXX	Data Visualization	DSC-8	3-0-0	3
DAS MDXXX	Data Visualization lab	DSC-8	0-0-2	1
DAS MDXXX	Elective	DSE-3	2-0-4	4
DAS MDXXX	Elective	DSE-4	2-0-4	4
				Total Credit=20

Semester – II (Electives)
Students can choose any two electives from the list.

1. Big Data Tools & Technologies-II
2. Time Series
3. Cloud Computing
4. Pattern Recognition

Semester – III

Course Code	Course Name	Type of Course	L-T-P	Credit
DAS MDXXX	Deep Learning & Neural Networks	DSC-4	3-0-0	3
DAS MDXXX	Deep Learning & Neural Networks Lab	DSC-4	0-0-2	1
DAS MDXXX	Generalized & Linear Modeling	DSC-7	3-0-0	3
DAS MDXXX	Generalized & Linear Modeling lab	DSC-7	0-0-2	1
DAS MDXXX	Graph & Social Network Analysis	DSC-9	3-0-0	3
DAS MDXXX	Graph & Social Network Analysis Lab	DSC-9	0-0-2	1
DAS MDXXX	Elective	DSE-6	2-0-4	4
DAS MDXXX	Elective	DSE-6	2-0-4	4
				Total Credit=20

Semester – III (Electives)
Students can choose any two electives from the list.

1. Natural Language Processing
2. Big Data Tools & Technologies-III
3. Customer Behavior Analysis and Fraud detection
4. Blockchain
5. Next Generation Sequencing Data Analysis
6. Emerging technologies in AI

Semester – IV

Course Code	Course Name	Type of Course	L-T-P	Credit
DAS MDXXX	Research Thesis / Project /Patent	Project	0-0-40	20
				Total Credit=20

Outcomes expected of Research thesis/project/Patent **in the 2nd Year of PG Programmes**

Semester – IV (Applicable to Structure 2)
The following outcomes must be achieved by the end of the IV Semester:

i. Research Problem Identification
ii. Review of literature
iii. Research design formulation
iv. Commencement of experimentation, fieldwork, or similar tasks
v. Completion of experimentation/ fieldwork
vi. Submission of dissertation, presentation with Viva Voce
vii. Research output in the form of any one of the following –

- Prototype or product development/ patent
- Publication/Presentation of research work in National/International Conference/conference proceedings
- Publication in a reputed journal such as Scopus-indexed journals or other similar quality journals
- Book or Book Chapter in a publication by a reputed publisher.
- Development of software or Database/Analysis pipeline/ Extensive analysis of Data
- Any other scholastic work as recommended by the School Research Committee and approved by the competent authority.

Summary (Excluding contact hours of Project)

	First Semester	Second Semester	Third Semester	Fourth Semester	Total
Credits	22	20	20	20	82
Contact Hours (L+T+P) **Structure 2**	28	24	24	-	76

STATISTICS AND PROBABILITY FOR ANALYTICS

Credit Units:3-0-0

Course Contents:

Introduction to Data analysis and Types : Data Analysis Types of Data Analysis – Descriptive, Exploratory, Predictive, Inferential, Steps in Data Analysis

Unit 1: Descriptive Statistics
Statistics: Preliminary concepts; Measures of Central Tendency: Mean, Median, Mode
Measures of Dispersion: Range, Standard deviation, Variance, Covariance, Graphical Representation of Statistics: Histograms, Bar plots, Scatter plots etc.

Unit 2: Probability: Random Experiments, Trial and Event, Sample Space, Mutually Exclusive or Disjoint Events, Mutually Exhaustive Events, Equally Probable Events, Complementary Event, Classical definition of Probability, Statistical definition of Probability, Axiomatic definition of Probability, Addition theorem, Multiplication theorem, Conditional Probability, Bayes' Theorem. Expectation. Binomial and Poisson Probability Distributions. Continuous Distribution: Normal Distribution, Properties of Normal distribution

Unit 3: Correlation: Bivariate distribution Correlation, Types of Correlation, Simple Correlation Coefficient for ungrouped data, Properties and Interpretation of Correlation Coefficient, Coefficient of determination, Scatter diagram, Standard Error, Probable error of Correlation Coefficient. Rank correlation, Some examples.

Unit 4: Introduction to the Inferential Statistics: Parameter, Statistic, Null hypothesis, Alternative hypothesis, Critical region, Type1 Error, Type 11 Error, Level of significance, P-value and its applications. Test of Significance for Small samples: One sample t-test, Paired t-test, Degrees of freedom for t-test, F test for equality of Population variances, Degrees of freedom for F-test. Test of Significance for Large samples: Normal test for sample mean and population mean, Normal test for two sample means. Chi-square Test: Test of goodness of fit, Test of Independence of attributes, Degrees of freedom for Chi Square test, Coefficient of contingency, Yates' correction for continuity. Analysis of Variance: One way and Two way (only Examples) , Introduction to Model Building: Basics of Model building, Definition of a Model, Point estimation, Confidence intervals.

Course Outcome:

S.N.	Course Outcome	CO
1	Understanding the basics of statistics and their advancement for big data analysis	CO1
2	Description of data points distribution to understand their range, central tendencies (mean, median), and dispersion (variance, standard deviation).	CO2
3	Understanding various graphics plots such as bar, histogram and pi-chart etc.	CO3
4	Understanding probability, correlation and their application	CO4
5	Identification of statistical errors and methods for a data set	CO5

Text & References:

- A first course in Probability, Sheldon Ross
- An introduction to Probability and Statistics, Vijay K. Rohatgi and A. K. Md. Ehsanes Saleh
- Biostatistics: A foundation for analysis in the Health Sciences, W.W Daniel. Publisher: John Wiley and Sons.
- Biostatistics, P.N Arora and P.K Malhan. Publisher: Himalaya Publishing House.
- S. Ross, A First Course in Probability, 10th ed. Boston, MA: Pearson, 2018, ISBN: 978-0134753119.
- L. Wasserman, All of Statistics: A Concise Course in Statistical Inference, 1st ed. New York, NY: Springer, 2004, ISBN: 978-0387402727.
- G. Casella and R. L. Berger, Statistical Inference, 2nd ed. Boston, MA: Cengage Learning, 2001, ISBN: 978-0534243128.
- An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 978-1071614174
- Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, Peter Gedeck, O'Reilly Media, 978-1492072942

STATISTICS AND PROBABILITY FOR ANALYTICS LAB

Credit Units: 0-0-1

Course Contents:

Unit 1: Descriptive Statistics: Calculation and interpretation of Descriptive Statistics

Unit 2: Probability: Understanding the preliminary concepts of probability through case studies, Continuous Distribution: Generation of statistical distributions

Unit 3: Correlation: Calculation of correlation understanding and interpreting correlation through case studies

Unit 4: Introduction to the Inferential Statistics: Understanding inferential statistics through case studies, Introduction to Model Building: Understanding Basics of Model building, Definition of a Model, Point estimation, Confidence intervals, Testing through case studies.

Course Outcome:

S.N.	Course Outcome	CO
1	Understanding the basics of statistics and their advancement for big data analysis	CO1
2	Description of data points distribution to understand their range, central tendencies (mean, median), and dispersion (variance, standard deviation).	CO2
3	Understanding various graphics plots such as bar, histogram and pi-chart etc.	CO3
4	Understanding probability, correlation and their application	CO4
5	Identification of statistical errors and methods for a data set	CO5

Text & References:

- A first course in Probability, Sheldon Ross
- An introduction to Probability and Statistics, Vijay K. Rohatgi and A. K. Md. Ehsanes Saleh
- Biostatistics: A foundation for analysis in the Health Sciences, W.W Daniel. Publisher: John Wiley and Sons.

- Biostatistics, P.N Arora and P.K Malhan. Publisher: Himalaya Publishing House.
- Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, Peter Gedeck, O'Reilly Media, 978-1492072942

Research Methodology

Credit Units: 3-0-0

Course Contents:

Unit 1: Research: Definition, Characteristics, Objectives, Research and Scientific method Types of Research: Descriptive vs. Analytical Research, Applied vs. I, Fundamental Research, Quantitative vs. Qualitative Research, Conceptual vs. Empirical Research, Research Problem: Research Problem, Selecting the problem, Necessity of Defining the problem, Technique Involved in Defining a Problem.

Unit 2: Research Design, and Data Collection: Research Design: Meaning, Need, Features of Good Design, Concepts, Relating to Research Design, Different Research Design, Basic Principle of Experimental Designs. Data Collection: Observation Method, Interview Method, Questionnaires, Case Study Method. Big Data and Data Science, why data science? Who is a Data Scientist? Data Science Life Cycle

Unit 3: Data Science Process: Overview, defining goals, Retrieving data, Data preparation, Data exploration, Data modeling, Presentation. Sampling, Measurement and Scaling Techniques Sampling: Steps in Sampling Design, Different Types of Sample Designs, Measurement and Scaling: Measurement in Research, Measurement Scales, Technique of Developing Measurement Tools, Scaling, Important Scaling Techniques. Data processing: Data description, Data processing, Importance of data preparation, feature engineering and scaling of datasets, Data imbalance, Data normalization and standardization, Treatment of missing values

Unit 4: Ethics in Research and Data Science: Research ethics, Data Science ethics: Doing good data science, – Owners of the data, Valuing different aspects of privacy, Getting informed consent, The Five Cs, Diversity, Inclusion. Report Writing: Significance of Report Writing, Different Steps in Writing Report, Layouts of Research Report, Types of Reports, Oral Presentation, Mechanics and Precautions for Writing Research Report.

Course Outcome:

S.N.	Course Outcome	CO
1	Understanding the Fundamentals of Research, formulation of research problems and hypothesis	CO1
2	Understanding how to collect data, ethics in data collection and preprocessing of data	CO2
3	Basic understanding of Ethical and Legal Aspects of Research	CO3
4	Making review of research, writing reports and presentation	CO4

Text & References:

- An Introduction to Data Science, Jeffrey Stanton, Syracuse University, SAGE Publications, Inc, ISBN: 978-1506377537, 2017
- A Simple Introduction to DATA SCIENCE, Lars Nielsen, Noreen Burlingame
- Introduction to Data Science, DAN POTTER, CARSTEN BINNING,ELI UPFAL
- Davy Cielen and Arno Meysman, Introducing Data Science. Simon and Schuster, 2016.
- M. Loukides, H. Mason, and D. Patil, Ethics and Data Science. O'Reilly Media, 2018.
- C. R. Kothari, Research Methodology Methods and Techniques. 3rd. ed. New Delhi: NewAge International Publishers, Reprint 2014.
- Zina O'Leary, The Essential Guide of Doing Research. New Delhi: PHI, 2005

Mathematics Essential

Credit Units-NC

Course Contents:

Unit1: Set Theory - Number system, Sets and their operations, Relations and functions - Relations and their types, Functions and their types, Sequence and Limits - Function of One variable - Function of one variable, Graphs and Tangents, Limits for sequences, Limits for function of one variable, Limits and Continuity

Unit 2: Linear algebra, vector spaces and transformations in n-dimensions. Matrix Operations (Addition, Multiplication, Inversion), formulating and solving linear systems as matrix-vector equations, performing basic computations involving matrix algebra, orthogonal projections, and eigenvalue-eigenvector problems. Singular Value Decomposition (SVD), Principal Component Analysis (PCA)

Unit 3: Derivatives, Tangents and Critical points - Differentiability and the derivative, Computing derivatives and L'Hˆopital's rule Derivatives, tangents and linear approximation, Critical points: local maxima and minima, Partial Derivatives,

Course Outcome:

S.N.	Course Outcome	CO
1	Establishment of fundamental aspect of mathematics	CO1
2	Development of analytical and problem solving skills	CO2
3	Understanding of linear algebra, vector space, operation on matrices etc	CO3
4	Finding optimization : local maxima and minima, derivatives	CO4

Text & References:

- G. Strang, Linear Algebra and Its Applications, 4th ed. Boston, MA: Cengage Learning, 2006, ISBN: 978-0030105678.
- Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 978-1108455145

- C. D. Meyer, Matrix Analysis and Applied Linear Algebra, 1st ed. Philadelphia, PA: SIAM, 2000, ISBN: 978-0898714548.
- Stewart, Calculus: Early Transcendentals, 8th ed. Boston, MA: Cengage Learning, 2015, ISBN: 978-1285741550.
- S. Boyd and L. Vandenberghe, Convex Optimization, 1st ed. Cambridge, UK: Cambridge University Press, 2004, ISBN: 978-0521833783.
- M. P. Deisenroth, A. A. Faisal, and C. S. Ong, Mathematics for Machine Learning, 1st ed. Cambridge, UK: Cambridge University Press, 2020, ISBN: 978-1108455145.

PROGRAMMING IN R

Credit Units: 2-0-2

Course Contents:

Unit 1: An Introduction to R, Overview of R programming, applications, usage and comparative study with other softwares and introduction to R for Data Science, Setting up the R environment and packages. Setting up R environment and install packages and supporting libraries in R, Basics of R : Manage your data and workspace, Save your work, How to use R, Data structure in R, Data creation and curation and special function using R, Matrices and Lists

Unit 2: File Handling: Reading different file format using R, file handling and processing, writing output file. Graphics using R: Graphics device, Basic plot function, scatter plot, 3-D scatter plot, pair plots, Lineplot, Matplot Matpoints, Bar plot, Histogram plot, Density plot, Dot plot, Pie chart, Venn diagram, Grid graphics, Lattice, ggplot2, Interactive plotting, combine multiple plots in same graphics screen, save graphics to a file., Conditional Executions, Comparison Operators, Logical Operators, Control Structures, If statements, Ifelse statements, Loops, For loop, While loop, Apply loop family, Other loops,

Unit 3: Functions: Define and Call functions, Syntax Rules for functions, Control utilities for functions, Writing own function, Advance R, Advance R functions and Regular expressions, Object oriented programming, Building R package

Course Outcome:

S.N.	Course Outcome	CO
1	Understanding the concept of programming in R and basic of setup environment	CO1
2	Develop Skills for Data Manipulation	CO2
3	Enable Data Visualization	CO3
4	Perform statistical analysis on various datasets	CO4
5	Application of R in machine learning and artificial intelligence	CO5

Text & References:

- A Handbook of Statistical analysis using R, Brain Everitt and Torsten Hothorn
- The art of R programming, Norman Matloff
- Data Analysis and Graphics using R, W. John Braun
- R Graphics, Paul murrell
- R for Data Science, Garrett Grolemund and Hadley Wickham
- Linear Models with R, Julian J. Faraway
- An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 978-1071614174

Syllabus - Second Semester

REGRESSION THEORY & ANALYSIS

Credit Units: 3-0-0

Course Contents:

Unit 1: Simple linear regression: Estimation of the Parameters, Hypothesis Testing on the Slope and Intercept, Interval Estimation in Simple Linear Regression, Prediction of New Observations, Coefficient of Determination, Multiple regression: Estimation of Parameters, Hypothesis Testing, Confidence Intervals, Prediction, Model Adequacy testing: Residual Analysis, PRESS statistic, Lack of Fit

Unit 2: Transformations: Variance stabilizing transformations, Transformations to linearize the model, Methods to select a transformation, weighted least squares, Regression and random effect, Multicollinearity: Sources, Effects, Diagnostics, Methods of dealing with Multicollinearity

Unit 3: Validation of regression models: Techniques for validation, Nonlinear least squares, transformations, Parameter estimation, Logistic and Poisson regression

Course Outcome:

S.N.	Course Outcome	CO
1	Understanding regression analysis for predictive model development	CO1
2	To be able to handle linear and multiple regression	CO2
3	Identification of patterns in Data	CO3
4	Establishment of relationship between variables	CO4

Text & References:

- Introduction to Linear Regression Analysis, by Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining
- Introduction to Regression Analysis, M. Golberg and H.A Cho
- Applied Regression Analysis, Norman R. Draper and Harry Smith

REGRESSION THEORY & ANALYSIS LAB

Credit Units: 0-0-1
Course Contents:

Unit 1: Simple linear regression: Estimation of the Parameters, Hypothesis Testing on the Slope and Intercept, Interval Estimation in Simple Linear Regression, Prediction of New Observations, Coefficient of Determination through case studies Multiple regression: Estimation of Parameters, Hypothesis Testing, Confidence Intervals, Prediction through case studies

Unit 2: Model Adequacy testing: Residual Analysis, PRESS statistic, Lack of Fit through case studies

Unit 3: Multicollinearity: Sources, Effects, Diagnostics, Methods of dealing with Multicollinearity through case studies

Course Outcome:

S.N.	Course Outcome	CO
1	Understanding regression analysis for predictive model development	CO1
2	To be able to handle linear and multiple regression	CO2
3	Identification of patterns in Data	CO3
4	Establishment of relationship between variables	CO4

Text & References:

- Introduction to Linear Regression Analysis, by Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining
- Introduction to Regression Analysis, M. Golberg and H.A Cho
- Applied Regression Analysis, Norman R. Draper and Harry Smith

TIME SERIES

Credit Units:2-0-2

Course Contents: Introduction to time series

Unit 1: Autoregressive-moving average models ARIMA: Moving average models MA(q). Condition of invertability. Autoregressive models AR(p). Yull-Worker). Yull-Worker equations. Stationarity conditions. Autoregressive-moving average models ARMA (p,q).

Unit 2: Coefficient estimation in ARIMA processes: Coefficients estimation in autoregressive models. Coefficient estimation in ARMA (p) processes. Quality of adjustment of time series models. AIC information criterion. BIC information criterion. "Portmonto" statistics.

Unit 3: Forecasting in the framework of Box-Jenkins model Forecasting, trend and seasonality in Box-Jenkins model. Non-stationary time series, Non-stationary time series. Time series with non-stationary variance. Non-stationary mean. ARIMA (p,d,q) models. The use of Box-Jenkins methodology to determination of order of integration.

Course Outcome:

S.N.	Course Outcome	CO
1	Understanding the principles of autoregressive-moving average models (ARIMA)	CO1
2	Estimation of coefficients in ARIMA processes	CO2
3	Explain the methodology for forecasting	CO3
4	Apply time series models to real-world datasets for forecasting and decision-making applications.	CO4

Text & References:

- Enders W. Applied Econometric Time Series. John Wiley & Sons, Inc., 1995
- Mills, T.C. The Econometric Modelling of Financial Time Series. Cambridge University Press, 1999
- Andrew C. Harvey. Time Series Models. Harvester wheatsheaf, 1993.

Syllabus - Third Semester

GENERALIZED & LINEAR MODELING

Credit Units:3-0-1

Course Contents:

Unit 1: Introduction to Generalized Linear Models: Linear model, Non linear model, GLM, Linear Regression Models: Multiple regression model, Parameter estimation, Maximum likelihood, Model adequacy checking, Weighted least squares.

Unit 2: Nonlinear Regression Models: Linear and Nonlinear regression models, transforming a linear model, Parameter estimation Logistic and Poisson Regression Models: Logistic regression, Poison regression, Overdispersion

Unit 3: The Generalized Linear Model: Exponential family, Likelihood equations, Quasi likelihood, Gamma family, The power function, Generalized Estimating Equation, ordinary least squares (OLS), model selection and evaluation: AIC, BIC, cross-validation, and likelihood ratio tests.

Course Outcome:

S.N.	Course Outcome	CO
1	Understand the theory and assumptions underlying linear regression models	CO1
2	Analyse and interpret the results of linear regression and multiple linear regression	CO2
3	Application of Nonlinear Regression Models and OLS	CO3
4	Conduct model selection and evaluation	CO4

Text & References:

- Generalised Linear Models: With Applications in Engineering and the Sciences by Raymond H. Mysers, Douglas C. Montgomery, G. Geoffrey Vining, Timothy J. Robinson
- Data Analysis Using Regression and Multilevel/ Hierarchical Models, Andew Gelman and Jennifer Hill
- Categorical data analysis, Ala Agresti

GENERALIZED & LINEAR MODELING LAB

Credit Units: 0-0-1
Course contents:

Unit 1: Linear Regression Models:
Multiple regression model, Parameter estimation, Maximum likelihood, Model adequacy checking, Weighted least squares with case studies

Unit 2: Nonlinear Regression Models: Linear and Non linear regression models, transforming a linear model, Parameter estimation with case studies, **Logistic and Poisson Regression Models:** Logistic regression, Poison regression, Overdispersion with case studies

Unit 3: The Generalized Linear Model: Exponential family, Likelihood equations, Quasi likelihood, Gamma family, The power function, Generalized Estimating Equation with case studies. ordinary least squares (OLS), model selection and evaluation: AIC, BIC, cross-validation, and likelihood ratio tests.

Course Outcome:

S.N.	Course Outcome	CO
1	Understand the theory and assumptions underlying linear regression models	CO1
2	Analyse and interpret the results of linear regression and multiple linear regression	CO2
3	Application of Nonlinear Regression Models and OLS	CO3
4	Conduct model selection and evaluation	CO4

Text & References:
- Generalised Linear Models: With Applications in Engineering and the Sciences by Raymond H. Mysers, Douglas C. Montgomery, G. Geoffrey Vining, Timothy J. Robinson
- Data Analysis Using Regression and Multilevel/ Hierarchical Models, Andew Gelman and Jennifer Hill
- Categorical data analysis, Ala Agresti

GRAPH & SOCIAL NETWORK ANALYSIS

Credit Units: 3-0-0

Course Contents:

Unit 1: Introduction to graph theory : Use of graph theory to construct different types of networks : Undirected, directed graphs, Cyclic, Directed acyclic graphs, trees, weighted graphs, bipartite graph, Study data structures of the graphs. Adjacency matrix, adjacency list. Study different network

models: Small world phenomena, Scale free network, Erdös-Rényi model for random graphs, Watts and Strogatz model, Barabasi-Albert model

Unit 2: Study network properties: Degree distribution, power law, graph density, graph isomorphism, path length, diameter, clique, shortest distance, clustering coefficient, network motifs, network centralities and node ranking, degree centrality, closeness centrality, betweenness centrality, eigenvector centrality, eccentricity, centracility, subgraph centrality, matching index, Network randomization: Randomization with Erdös-Rényi model, Randomization with node degree conservation, Permutation of node labels

Unit 3: Introduction to social network: Introduction to social network data, Different data format, Paths and Connectivity-Graphs to represent social relations. Working with network data- Network Datasets-Strong and weak ties - Closure, Structural Holes, and Social Capital.: Data and Text Mining In Social Media: Data mining in nutshell, Social media, Motivations for data mining in social media, Data mining methods for social media. Social networking sites: illustrative examples. Text Mining: Keyword search, query semantics and answer ranking, Classification algorithms, Clustering algorithms., Community Detection in Social Networks: Introduction, Communities in context, core methods and algorithm for community detection, Quality functions, Agglomerative/Divisive algorithms, discuss different approached for clustering.

Course Outcome:

S.N.	Course Outcome	CO
1	Understand and explain fundamental concepts of graph theory, network science and graph representation methods	CO1
2	Apply different network models	CO2
3	Analyse and compute key network properties	CO3
4	Investigate the behaviour of social networks	CO4

Text & References:

- Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010
- Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010.
- Easley and Kleinberg, "Networks, Crowds, and Markets: Reasoning about a highly connected world", Cambridge Univ. Press, 2010.
- Charu C. Aggarwal, "Social Network Data Analytics", Springer, 2011.
- Robert A. Hanneman and Mark Riddle, "Introduction to social network methods", University of California, 2005.
- Jure Leskovec, AnandRajaraman, and Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press, 2 edition, 2014.
- Wasserman, S., & Faust, K, "Social Network Analysis: Methods and Applications", Cambridge University Press; 1 edition, 1994.

GRAPH & SOCIAL NETWORK ANALYSIS LAB

Credit Units: 0-0-1

Course contents:

Unit 1: Study Tools for graphs and network study : Case studies will be implemented by using any programming language such as R or python. Learn other tools like Cytoscape and Gephi, and igraph, Introduction to graph theory: Input graph data : Read different network format, load network data, Construct network from matrix, Adjacency matrix. Input different types of networks : Undirected, directed graphs, Cyclic, Directed acyclic graphs, trees, weighted graphs, bipartite graph. Study data structures of the graphs. Adjacency matrix, adjacency list. Study different network models : Small world phenomena, Scale free network, Erdös-Rényi model for random graphs, Watts and Strogatz model, Barabasi-Albert model

Unit 2: Study network properties: Degree distribution, power law, graph density, graph isomorphism, path length, diameter, clique, shortest distance, clustering coefficient, network motifs, network centralities and node ranking, degree centrality, closeness centrality, betweenness centrality, eigenvector centrality, ecentricity centracility, subgraph centrality, matching index, Network randomization: Randomization with Erdös-Rényi model, Randomization with node degree conservation, Permutation of node labels

Unit 3: Introduction to social network: Introduction to social network data, Different data format, Paths and Connectivity-Graphs to represent social relations. Working with network data- Network Datasets-Strong and weak ties - Closure, Structural Holes, and Social Capital., Data and Text Mining In Social Media, Data mining in nutshell, Social media, Motivations for data mining in social media, Data mining methods for social media. Social networking sites: illustrative examples. Text Mining: Keyword search, query semantics and answer ranking, Classification algorithms, Clustering algorithms., Community Detection in Social Networks: Introduction, Communities in context, core methods and algorithm for community detection, Quality functions, Agglomerative/Divisive algorithms, discuss different approached for clustering.

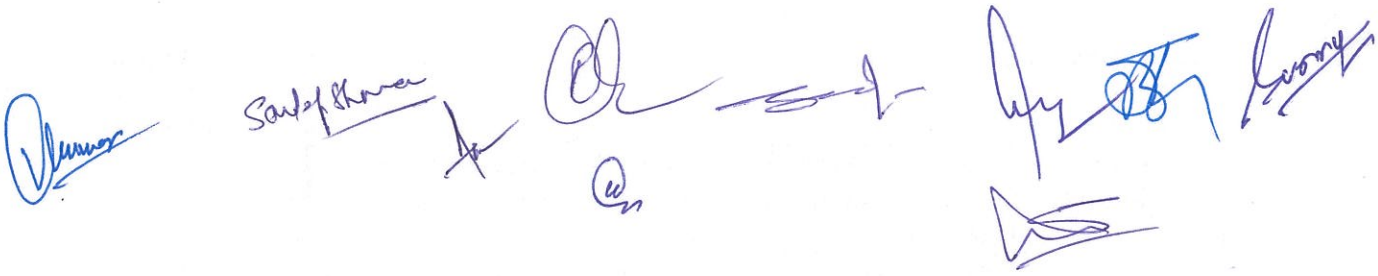
Course Outcome:

S.N.	Course Outcome	CO
1	Understand and explain fundamental concepts of graph theory, network science and graph representation methods	CO1
2	Apply different network models	CO2
3	Analyse and compute key network properties	CO3
4	Investigate the behaviour of social networks	CO4

Text & References:

- Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010
- Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010.
- Easley and Kleinberg, "Networks, Crowds, and Markets: Reasoning about a highly connected world", Cambridge Univ. Press, 2010.

- Charu C. Aggarwal, "Social Network Data Analytics", Springer, 2011.
- Robert A. Hanneman and Mark Riddle, "Introduction to social network methods", University of California, 2005.
- Jure Leskovec, AnandRajaraman, and Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press, 2 edition, 2014.
- Wasserman, S., & Faust, K, "Social Network Analysis: Methods and Applications", Cambridge University Press; 1 edition, 1994.



Annexure-II

Course Code : MTL AE 104
Course Title : Fundamental of Integral Transforms & Complex Analysis

L-T-P/S=Credits : 2-0-0 =2
Course Category : AEC
Pre-requisite Courses (if any) :
Equal Course Code (if any) :
Equivalent Course Code (if any):

Detailed Syllabus

Sr	Contents	Approx. Contact Hours
1	Odd & even functions, Periodic functions, Fourier series, Euler's formulas, Dirichlet's conditions, Fourier series for discontinuous functions, Change of interval, Half range series.	08
2	Laplace transform, Existence of Laplace transform, Laplace transform & its properties, Inverse Laplace transform, Convolution theorem, Applications of Laplace Transform to solve differential equations.	08
3	Complex numbers and its properties, Polar representation, De Moivre's theorem and its applications in finding the roots of complex numbers, Function of complex variables, Exponential functions, Logarithmic functions, Hyperbolic functions.	08

Suggested Books:

Sr.	Name of Book, Author, Publisher	Year of Publication / Reprint
Text Books		
1	Engineering Mathematics, N.P. Bali, Laxmi Publications, Latest Edition.	
2	Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, Latest Edition.	
3	McQuarri Macmillan, Mathematical Methods by Scientists & Engineers, 1st edition 2003	
4	Complex Analysis, M.R. Spiegel, Schaum's Outline, Latest Edition series.	
Reference Books		
1		

2		

Annexure-III

Integrated B.Sc./M.Sc. Course Structure (Mathematics)

FYUG COURSE STRUCTURE AS PER NEP 2020 (2024 onwards)

COURSE STRUCTURE AS PER NEP 2020

Integrated programs Batch 2022 and 2023

&

FYUP Programs (Four years) from 2024 onwards

Semester-I

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD101	Differential Calculus	4-0-0	4
Minor	XXX MI XXX	Choose one from the pool of Courses from allied schools	4-0-0	4
Multidisciplinary	XXX MU XXX		3-0-0	3
Ability Enhancement Course	XXX AE XXX		3-0-0	3
Skill Enhancement course	XXX SE XXX		2-0-0/ 1-0-2	2
Value added course-1	XXX VA XXX		2-0-0	2
Value added course-2	XXX VA XXX		2-0-0	2
		Total Credits	**20-0-0/ 19-0-1**	**20**

Minor

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Minor	MTL MI101	Elements of Discrete Mathematics	4-0-0	4

Multidisciplinary Courses from Mathematics for other Departments/Disciplines:

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Multidisciplinary	MTL MU101	Fundamentals of	3-0-0	3

		Calculus and applications		

Semester-II

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD102	Integral Calculus	4-0-0	4
Minor	XXX MI XXX	Choose one from the pool of Courses from allied schools	4-0-0	4
Multidisciplinary	XXX MU XXX		3-0-0	3
Ability Enhancement Course	XXX AE XXX		3-0-0/ 2-1-0	3
Skill Enhancement course	XXX SE XXX		2-0-0/ 1-0-2	2
Value added course-3	XXX VA XXX		2-0-0	2
Value added course-4	XXX VA XXX		2-0-0	2
		Total Credits	**20-0-0/ 18-1-1**	**20**

Minor

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Minor	MTL MI102	Analytical Geometry of 3-D and Trigonometry	4-0-0	4

Multidisciplinary Courses from Mathematics for other Departments/Disciplines:

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Multidisciplinary	MTL MU102	Probability & Statistics with Applications	3-0-0	3

Semester-III

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD201	Fundamentals of Algebra	4-0-0	4
Major	MTL MD203	Real Analysis-I	4-0-0	4
Minor/ DSE-1	MTL MI201 MTM MI201	Computer Programming(MTL-2241) Computer Programming Lab(MTP-2241)	4-0-0 0-0-2	4 1
Multidisciplinary	XXX MU XXX		3-0-0	3
Ability Enhancement Course	XXX AE XXX		3-0-0	3
Skill Enhancement course	XXX SE XXX		2-0-0/ 1-0-2	2
		Total Credits	**20-0-0/ 19-0-1**	**20**

	Minor/ DSE-1		
Course Code	Course Name	L-T-P **	Credits
MTL MI201 MTM MI201	Computer Programming Computer Programming Lab(MTP-2241)	3-0-0 0-0-2	3 1
MTL MI203	Theory of Reliability	4-0-0	4

Multidisciplinary Courses from Mathematics for other Departments/Disciplines:

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Multidisciplinary	MTL MU201	Discrete Structures with Applications	3-0-0	3

Semester-IV

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD202	Real Analysis-II	4-0-0	4
Major	MTL MD204 MTM MD204	Probability and Statistics Probability and Statistics Lab	3-0-0 0-0-2	3 1
Major	MTL MD206	Vector Calculus	4-0-0	4
Major	MTL MD208	Fundamentals of Complex Variables	4-0-0	4
Minor/ DSE-2				
		Total Credits	**19-0-2**	**20**

	Minor/ DSE-2		
Course Code	Course Name	L-T-P **	Credits
MTL MI202	Set Theory	4-0-0	**4**
MTL MI204	Information Theory	4-0-0	4
MTL MI206	Biomathematics	4-0-0	4

Semester-V

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD301	Multivariable Calculus	4-1-0	5
Major	MTL MD303	Linear Algebra	4-0-0	4
Major	MTL MD305	Metric Spaces	4-0-0	4
Minor/ DSE-3				
IAPC				2
Skill Enhancement course	XXX SE XXX		2-0-0/ 1-0-2	2
		Total Credits		**20**

	Minor/ DSE-3		
Course Code	Course Name	L-T-P **	Credits
MTL MI301	Integral Transforms	4-0-0	4
MTL MI303	Decision Theory	4-0-0	4
MTL MI305	Econometrics	4-0-0	4
MTL MI307	Fuzzy Logic and Applications	4-0-0	4

Semester-VI

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD302	Ordinary Differential Equation	4-0-0	4
Major	MTL MD304	Number Theory & Cryptography	4-0-0	4
Major	MTL MD306	Coding Theory	4-0-0	4
Major	MTL MD308	Graph Theory	4-0-0	4
Minor/ DSE-4				
		Total Credits	**20-0-0**	**20**

	Minor/ DSE-4		
Course Code	Course Name	L-T-P **	Credits
MTL MI302	Linear Programming and Game Theory	4-0-0	4
MTL MI306	Financial Mathematics	4-0-0	4

Semester-VII

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD401	Abstract Algebra	4-0-0	4
Major	MTL MD403	Advanced Real Analysis	4-0-0	4
Major	MTL MD405	Partial Differential Equations	4-0-0	4
Major	MTL MD407	Basic Research Methodology for	4-0-0	4

		Beginners		
Minor/ DSE-5				
		Total Credits	**20-0-0**	**20**

	Minor/ DSE-5		
Course Code	Course Name	L-T-P **	Credits
MTL MI401	Advanced Calculus and Special Functions	4-0-0	4
MTL MI403	Numerical Methods	4-0-0	4

Semester-VIII

Broad Category of Course	**Course Code**	**Course Title**	**L-T-P**	**Credits**
Major	MTL MD402	Complex Analysis	4-0-0	4
Major	MTL MD404	Advanced Linear Algebra	4-0-0	4
Major	MTL MD406	Differential and Integral Equations	4-0-0	4
Major	MTL MD408	Algebraic number theory	4-0-0	4
Minor/ DSE-6				
		Total Credits	**20-0-0**	**20**

OR

Broad Category of Course	**Course Code**	**Course Title**	**L-T-P**	**Credits**
Major	MTL MD402	Complex Analysis	4-0-0	4
Minor/ DSE-6				
Research Project/Dissertation	MTD MD402		12-0-0	12
		Total Credits	**20-0-0**	**20**

	Minor/ DSE-6		
Course Code	Course Name	L-T-P **	Credits
MTL MI402	Numerical Solution of Ordinary and Partial Differential Equations	4-0-0	4
MTL MI404	Commutative Algebra	4-0-0	4

Semester-IX

Broad Category of	**Course Code**	**Course Title**	**L-T-P**	**Credits**

Course				
Major	MTL MD501	Topology	4-0-0	4
Major	MTL MD503	Calculus of Variations and Mechanics	4-0-0	4
Minor/ DSE-7				
Minor/ DSE-8				
Research Project/Dissertation	MTD MD501		**12-0-0**	**12**
		Total Credits	**28-0-0**	**28**

	Minor/ DSE-7		
Course Code	Course Name	L-T-P **	Credits
MTL MI501	Optimization Techniques	4-0-0	4
MTL MI503	Sample Survey	4-0-0	4

	Minor/ DSE-8		
Course Code	Course Name	L-T-P **	Credits
MTL MI505	Advanced topics in Algebra	4-0-0	4
MTL MI507	Stochastic Processes	4-0-0	4

Semester-X

Broad Category of Course	Course Code	Course Title	L-T-P	Credits
Major	MTL MD502	Differential Geometry	4-0-0	4
Major	MTL MD504	Functional Analysis	4-0-0	4
Minor/ DSE-9				
Minor/ DSE-10				
Research Project/Dissertation	MTD MD502		12-0-0	12
		Total Credits	**28-0-0**	**28**

	Minor/ DSE-9		
Course Code	Course Name	L-T-P **	Credits
MTL MI502	Modern Applied Algebra	4-0-0	4

MTL MI504	Fluid Mechanics	4-0-0	4
	Minor/ DSE-10		
Course Code	Course Name	L-T-P **	Credits
MTL MI506	Measure Theory	4-0-0	4
MTL MI508	Advanced Topics in Topology	4-0-0	4
MTL MI510	Queuing Theory	4-0-0	4

LIST OF **MINOR/ DSE**C OURSES:

	Minor/ DSE-I		
Course Code	Course Name	L-T-P **	Credits
MTL MI201	Computer Programming(MTL-2241)	4-0-0	4
MTM MI201	Computer Programming Lab(MTP-2241)	0-0-2	1
MTL MI203	Theory of Reliability	4-0-0	4
	Minor/ DSE-2		
MTL MI202	Set Theory	4-0-0	4
MTL MI204	Information Theory	4-0-0	4
MTL MI206	Biomathematics	4-0-0	4
	Minor/ DSE-3		
MTL MI301	Integral Transforms	4-0-0	4
MTL MI303	Decision Theory	4-0-0	4
MTL MI305	Econometrics	4-0-0	4
	Minor/ DSE-4		
MTL MI302	Linear Programming and Game Theory	4-0-0	4
MTL MI304	Queuing Theory	4-0-0	4
MTL MI306	Financial Mathematics	4-0-0	4
	Minor/ DSE-5		
MTL MI401	Advanced Calculus and Special Functions	4-0-0	4

MTL MI403	Numerical Methods	4-0-0	4
	Minor/ DSE-6		
MTL MI402	Numerical Solution of Ordinary and Partial Differential Equations	4-0-0	4
MTL MI404	Commutative Algebra	4-0-0	4
	Minor/ DSE-7		
MTL MI501	Optimization Techniques	4-0-0	4
MTL MI503	Sample Survey	4-0-0	4
	Minor/ DSE-8		
MTL MI505	Advanced topics in Algebra	4-0-0	4
MTL MI507	Stochastic Processes	4-0-0	4
	Minor/ DSE-9		
MTL MI502	Modern Applied Algebra	4-0-0	4
MTL MI504	Fluid Mechanics	4-0-0	4
	Minor/ DSE-10		
MTL MI506	Measure Theory	4-0-0	4
MTL MI508	Advanced Topics in Topology	4-0-0	4

Metric Spaces

MTL MD 305 L-T-P: 4-0-0 (Credits=4)

Unit I

Definition and examples of metric spaces, Bounded and unbounded metric spaces, Distance between sets, Diameter of a set, Open and closed balls, interior points and interior of a set, open set, Neighborhood of a point, limit point of a set, closure of a set, closed set, boundary points and boundary point of set, exterior points and exterior of a set, subspace of a metric space.

Unit II

Sequences and subsequence in a metric space, convergent and Cauchy sequences, complete metric spaces, relation between completeness and closedness, Cantor Intersection Theorem,

Completion Theorem, Dense sets, Separable spaces, Nowhere dense sets, Categories and Baire Category Theorem.

Unit III

Cover of a Metric space, compact metric spaces, Compact sets and their criterion, properties of compact sets, Relation between compactness, completeness and closedness, finite intersection property, Bolzano Weirstrass property, Sequential compactness, totally bounded spaces, continuous functions between two metric spaces, Characterization of continuous function, continuous functions on compact spaces, Uniform continuous function.

Recommended Books

1. Q. H. Ansari: Metric spaces including fixed point theory and set-valued maps, Narosa Publishing House, New Delhi,2010
2. S. Shirali and H. Vasudeva, Metric spaces, Springer-Verlag, London, 2006.
3. G. F. Simmons, Introduction to topology and Modern Analysis, McGraw-Hill, 1963.
4. E. T. Copson, Metric spaces, Cambridge University Press, 1968.
5. S. Kumaresan, Topology of Metric spaces, Narosa Publishing House, 2nd Ed, 2011.