Program
M Sc Applied Statistics and Data Analytics

CURRICULUM AND SYLLABUS

(effective from the academic year 2017-18)

TABLE OF CONTENTS

PROGRAM OUTCOMES (PO)

PO1: Knowledge in Statistics and Computer Science

PO2: Problem solving techniques

PO3: Modeling and solutions

PO4: Understanding the complex problems

PO5: Applications to Business and Engineering problems

PO6: Modern software tools usage

PO7: Environment and Sustainability

PO8: Values and Ethics

PO9: Individual & Team work

PO10: Language and Communication

PO11: Project management and research

PO12: Lifelong learning

CURRICULUM STRUCTURE

M Sc APPLIED STATISTICS AND DATA ANALYTICS

(effective from the academic year 2017-18)

Semester I

Course code	Course	L T P	Credit	ES
17MAT506	Linear Algebra and Numerical Methods	4 0 0	4	A
17MAT507	Probability and Distributions	4 0 0	4	B
17MAT508	Statistical Estimation and Sampling Theory	4 0 0	4	C
17MAT509	Statistical Techniques for Data Analytics	4 0 0	4	D
17MAT510	Advanced Programming Language	3 0 2	4	E
15CUL501	Cultural Education	2 0 0	P/F	F
	Total		**20**	

Semester II

Course code	Course	L T P	Credit	ES
17MAT515	Advanced Optimization Techniques	4 0 0	4	A
17MAT516	Design of Experiments	4 0 0	4	B
17MAT517	Introduction to Data Science	4 0 0	4	C
17MAT518	Statistical Quality Control	4 0 0	4	D
17MAT519	Statistical Testing of Hypothesis	4 0 0	4	E
15AVP501	Amrita Value Programme	1 0 0	1	F
	Total		**21**	

Semester III

Course code	Course	L T P	Credit	ES
17MAT606	Algorithms for Advanced Computing	3 0 1	4	A
17MAT607	Big-Data Analytics	3 0 1	4	B
17MAT608	Multivariate Statistics for Data Analytics	3 0 1	4	C
	Elective I	3 0 0	3	D
	Elective II	3 0 0	3	E
15MAT690	Live-in-Lab.[@]/ Open Elective[*]	2 0 0	2	J
	Total		**20**	

Semester IV

Course code	Course	L T P	Credit	ES
	Elective III	3 0 0	3	E
15MAT696	Dissertation		10	P
	Total		**13**	

Total credits for the programme: 74

ELECTIVES (any two)

Course code	Course	L T P	Credit	ES
15MAT651	Queuing Theory and Inventory Control Theory	3 0 0	3	D/E
15MAT653	Statistical Pattern Classification	3 0 0	3	D/E
17MAT650	Advanced Big Data Analytics	3 0 0	3	D/E
17MAT657	Data Analysis for Biology	3 0 0	3	D/E
17MAT658	Marketing Analysis	3 0 0	3	D/E
17MAT659	Regression Analysis	3 0 0	3	D/E
17MAT660	Reliability Theory	3 0 0	3	D/E
17MAT670	Six Sigma Quality Analysis	3 0 0	3	D/E

**One Open Elective course is to be taken by each student, in the third semester, from the list of Open electives offered by the School.*

[@]Students undertaking and registering for a Live-in-Lab project, can be exempted from registering for the Open Elective course in the third semester.

Evaluation and Grading Scheme

50:50 (Internal: External) (All Theory Courses)

Assessment	Internal	External
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

80:20 (Internal: External) (Lab courses and Lab based Courses having 1 Theory hour)

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

70:30(Internal: External) (Lab based courses having 2 Theory hours/ Theory and Tutorial)

Theory- 60 Marks; Lab- 40 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	10	
Continuous Assessment (Lab) (CAL)	40	
End Semester		30

65:35 (Internal: External) (Lab based courses having 3 Theory hours/ Theory and Tutorial)

Theory- 70 Marks; Lab- 30 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Letter Grade	**Grade Point**	**Grade Description**
O	10.00	Outstanding
A+	9.50	Excellent
A	9.00	Very Good
B+	8.00	Good
B	7.00	Above Average
C	6.00	Average
P	5.00	Pass
F	0.00	Fail

Grades O to P indicate successful completion of the course

$$CGPA = \frac{\sum (C_i x Gr_i)}{\sum C_i}$$

Where

C_i = Credit for the i^{th} course in any semester

Gr_i= Grade point for the i^{th} course

Cr. = Credits for the Course

Gr. = Grade Obtained

Program Articulation Matrix

Course Code	Course Name	Program Outcomes											
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
17MAT507	PROBABILITY AND DISTRIBUTIONS	3		3		3							
		2	3		3								
		3	3										
		3		3		3							
		3	2	3		3							
17MAT508	STATISTICAL ESTIMATION THEORY AND SAMPLING THEORY	3	2	3	2	3							1
			3		2								1
		2	3		3								1
		3				3							1
		3				3							1
17MAT509	Statistical Methods for Data Analytics	3		2		3	1						1
		3	2			3	1						1
		3	2	2	2	3	1						1
		3	2	2	2	3	1						1
		3	2	2	2	3	1						1
17MAT506	LINEAR ALGEBRA AND NUMERICAL METHODS	3	3		3								
		3	3		3	2							
		3	3		3								
		2		3		3							
		2				3	1						
17MAT510	ADVANCED PROGRAMMING LANGUAGE	3			2		1					1	1
		3				3	2					1	1
						2	3					1	1
						2	3					1	1
		3				3	3					1	1
17MAT516	DESIGN OF EXPERIMENTS	3	2	3	2							1	1
		2		3		3	1					1	1
		2	2	3	2	3	1					1	1
		2				3	1					1	1
		3	2	3		3						1	1
17MAT518	STATISTICAL	3	2	2		3						1	1

	QUALITY CONTROL	2		3		3						1	1
		2		3	2	3						1	1
		3	2		3							1	1
		2				3						1	1
17MAT519	STATISTICAL TESTING OF HYPOTHSIS	3	2		3								
		2		3		3	1						
		2		3		3	1						
		3			3	3	1						
		3		2	3	3							
17MAT517	INTRODUCTION TO DATA SCIENCE	3	2		2								
		3	2	3		2							
		2			3		1						
		2			3		1						
		3			3		1						
17MAT606	ALGORITHMS FOR ADVANCED COMPUTING	3			3		1						
		3	2		2	3	1						
		2	2		2								
		2			3		2						
		2	2		3		1						
17MAT515	ADVANCED OPTIMIZATION TECHNIQUES	3	2	2	2	3	1						
		3	2	2	2	3	1						
		3	2		3	3	1						
		3	2		3	3	1						
		3	2		3	3	1						
17MAT608	MULTIVARIATE STATISTICS FOR DATA ANALYTICS	3	2		3								
		2	3		3								
		2	3		3		1						
		2	3		3		1						
				2		3	1						
17MAT658	MARKETING ANALYTICS			3		3	1					2	2
		3	3		3								
		3	3		3								
		3	3		3								
				2		3	1					2	2
17MAT607	BIG DATA ANALYTICS	3	3		3								
		2			2	3	1						
		2		3	2	3	1						
						3	2						
						3	2						
15MAT653	STATISTICAL PATTERN CLASSIFICATIONS	3	2		2								
		2	2	2	2								
				3		3	1						
		3	2		2								
				2		3	2						
15MAT696	Dissertation	3	3	3	3								
		2			3			1	3	2	3	3	2
			2		3				2	3	2	3	2
					2				3	2	3	3	2

17MAT670	SIX SIGMA QUALITY ANALYSIS	3	2		3								
		2		2		3	1						
		3			3								
		3	2		3								
		3	2		2	3							
17MAT657	DATA ANALYSIS IN BIOLOGY	3	2	2	2	3	1						
		3	2		2	3							
		3	2		2	3							
		3	2		2								
		3	2		2								
17MAT660	RELIABILITY THEORY	3	3		3								
				2		3	1						
		2			2	3							
		2	2	2	2								
		2	2		2								
15MAT651	QUEUING THEORY AND INVENTORY CONTROL THEORY	3	2	2	2								
		2		3									
		2				3							
		2	2		2								
		2	2		2								
MAT650	ADVANCED BIG DATA ANALYTICS	3	2		2								
		3	2		3								
					3								
				3		3	1						
		3			2	3	1						
17MAT659	REGRESSION ANALYSIS	3	2		3		1						
		3	2		3		1						
		3			3	3	1						
					3	3	1						
		2	2	2	2	3	1						

M Sc APPLIED STATISTICS AND DATA ANALYTICS

SYLLABUS

(effective from the academic year 2017-18)

17MAT506 LINEAR ALGEBRA AND NUMERICAL METHODS 4-0-0-4

Unit I

Vector Spaces: General vector spaces -Sub spaces -Linear independence -Basis –Dimension-Row space, Column space and Null Space –Rank and Nullity.

Unit –II

Inner Product Spaces: Inner products - Orthogonality-Orthogonal basis - Orthogonal complements -Projection on subspace -Gram Schmidt Process -QR-Decomposition- Best approximation -Least square -Least squares fitting to data - Change of basis

Unit-III

Linear Transformations: Linear transformation –General linear transformation -Kernel and range of a linear transformation -Inverse Linear Transformation -Matrices of general linear transformation-Nilpotent transformations Similarity –Diagonalization.

Unit IV

Selected Applications: Markov Chains, Games of Strategy,Leontief Economic Models, Cryptography, A Least Squares Model for Human Hearing .

Unit V

Numerical methods: Roots of Transcendental and Polynomial Equations: Bisection method, Newton-Raphson method, Secant Method, Solution to system of equations –iterative methods-Gauss Jacobi Method and Gauss seidel Method, Method of determining Eigenvalues and Eigenvectors by Power method.

Course Outcomes

CO1	Understand the concepts of vector spaces, rank and nullity.
CO2	To understand inner products and compute the angle/length of a vector. To construct the orthonormal basis.
CO3	To understand the construction of matrices for a linear transformation in different forms.
CO4	To familiarize the applications of linear algebra in markov chains and least square models.
CO5	To understand the iterative methods in solving transcendental and linear equations.

Textbooks*:*

1. Howard Anton and Chris Rorres, ‘Elementary Linear Algebra’, John Wiley & Sons, 1994, Seventh Edition.
2. M.K.Jain, S.R.K. Iyengar and R.K.jain, Numerical methods for Scientific and Engineering Computation, New Age International Publishers, 2007, Fifth edition

References:

1. Kenneth Hoffmann and Ray Kunze, ‘Linear Algebra’, Second Edition, Prentice Hall, 1971.
2. Kandasamy. P, Thilagavathi. K and Gunavathi. K “Numerical methods” – S. Chand and Company Ltd, New Delhi – Revised Edition 2007.

17MAT507 PROBABILITY AND DISTRIBUTIONS 4-0-0-4

Unit I

Introduction to probability,theorems on probability, independence of events, conditional probability, Baye's theorem and its applications. Random variables, Functions of random variables,discrete and continuous random variables, expectation,conditional probability,discrete probability space, general probability space, induced probability space, distribution function of a random variable, moments inequality.

Unit II

Convergence of random variables: convergence in probability, convergence almost sure, convergence in distribution, convergence in rth mean,Fubini theorem (Statement only) definition and properties of characteristic functions.

Unit III

Weak law of large numbers, Chebychev's law of large numbers. Khinchin's theorem and its applications. Kolmogorov's strong law of large numbers (both iid and non-iid cases). Demoivre -Laplace central limit theorem. Lindeberg -Levy's central limit theorem. Statement and discussion of Lindeberg - Feller's theorem.

Unit IV

Special distributions - Binomial , Multinomial, Poisson, Negative Binomial, Hypergeometric, Geometric, Uniform ,Exponential, Gamma, Beta, Normal, LogNormal,Sampling distributions of mean and variance, Central and Non-central distributions of t, F and Chi-Square distribution.

Unit V

Joint, marginal and conditional probability distributions for discrete and continuous cases, stochastic independence, expectation of two dimensional random variables, conditional mean and variance, transformation of one and two random variables, Bivariate Normal.

Course Outcomes

CO-1: To understand probability theory and related distribution functions

CO-2: To understand convergence theorems on random variables

CO-3: To get in-depth knowledge about law of large numbers

CO-4: To gain knowledge on distribution theory and apply types of probability distributions

CO-5: To study and apply two dimensional distributions

Text books :

1. B.R.Bhatt :Modern Probability Theory , An Introductory text book, Third edition, New Age International,2009
2. Ravichandran, J : Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

References :

Hogg R.V., Craig, A. And McKean J. W. (2005) Introduction to Mathematical Statistics, 6thEdition, Pearson

17MAT508 STATISTICAL ESTIMATION THEORY AND SAMPLING THEORY 4-0-0-4

Unit I

Criteria of point estimation – Standard parametric models of distributions. Consistent estimation of real valued parameters. Invariance of consistent estimators. Unbiasedness, sufficiency, and efficiency, minimum variance, Fisher's information, Cramer – Rao inequality, Bhattacharyya's bounds.

Unit II

Sufficiency, completeness, bounded completeness, Fisher-Neymann factorization theorem, minimal sufficiency, Rao-Black well theorem, Lehmann – Scheffe theorem.

Unit III

Methods of estimation: method of moments, method of maximum likelihood & their properties, Fisher's scoring method, method of minimum chi-square, method of modified minimum chi-square, confidence intervals, shortest confidence intervals.

Unit IV

Concept of population and sample, need for sampling, census & sample surveys, basic concepts in sampling and designing of large-scale surveys design, sampling scheme and sampling strategy. Basic methods of sample selection: SRSWR, SRSWOR.

Unit V

Finite population sampling techniques: SRSWR/WOR, stratified and systematic and related results on estimation of population mean and total allocation problems in stratified random sampling.

Course Outcomes

CO1 To gain knowledge over point estimation theory and some bounds on estimators

CO2 To understand and analyze the theorems on estimators

CO3 To gain knowledge about various methods of estimation

CO4 To understand and apply the basic sampling methods with and without replacement

CO5 To understand and apply stratified and systematic sampling methods

Text books

1. Rao C.R : Linear Statistical Inference and its Applications, John Wiley, New York, 1974
2. William G Cochran:Sampling techniques third edition. John Wiley, New York, 1977

References

Hogg R. V. and Craig A. T. , Introduction to Mathematical Statistics, Macmillan Publishing Company,1989

17MAT509 Statistical Methods for Data Analytics

Unit I: Data collection/generation and descriptive statistics

Data collection – types of data - Sampling methods – data generation methods- Bootstrap sampling – Jackknife sampling –- bias and variance- simulation – confidence levels - sample size determination – descriptive statistics.

Unit II: Fitting of data and Inferential statistics

Hypothesis testing -Fitting of distribution to data – Binomial – Poisson – uniform – exponential –Normal distributions — one- way, two-way- analysis of variance –- Multiple range test for one way ANOVA.

Unit III: Dimensionality Reduction Methods and supervised learning methods

Multivariate statistics – multivariate normal distribution – multivariate regression analysis – Principal component analysis – Linear discriminant analysis- Fisher's discriminant analysis – Statistical decision making - Bayesian classification

Unit IV: Unsupervised Machine learning and clustering

Data description and clustering – criterion functions for clustering – hierarchical clustering – agglomerative clustering algorithm – single linkage algorithm – complete linkage algorithm – average linkage algorithm - Partitional clustering – Forgy's algorithm – k-means algorithms.

Unit V: Nonmetric decision making

Histograms – kernel and window estimators – nearest neighbor classification techniques –adaptive decision boundaries - regression and classification Trees-decision trees – CART methods – Support Vector Machines.

Course Outcomes

CO1 To understand data collection methods and to apply descriptive statistics to data
CO2 To understand and apply data fitting methods and analyze the outcomes
CO3 To analyse data using dimensionality reduction methods
CO4 To understand and apply clustering methods
CO5 To understand and apply nonmetric decision making methods

Text Book/References:

1. Ravichandran . J. "Probability and Statistics for Engineers", First edition, Wiley, 2012.
2. Hastie, T., Tibshirani . R., and Friedman, J. The elements of statistical learning. Vol. 2. No. 1. New York: Springer, 2009.
3. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", Second Edition, 2003, John wily & sons.
4. Earl Gose, Richard Johnsonbaugh and Steve Jost, "Pattern Recognition and Image Analysis", 2002, Prentice Hall of India.

17MAT510 ADVANCED PROGRAMMING LANGUAGE 3-0-2-4

Unit – I

Downloading and Installing python, Python's basic data types, files, functions, and error handling, Assignment statements, variable names, expression and statements, script mode, string operations.

Unit- II

Function calls: math functions, composition, adding new functions , flow of execution, parameters and arguments, stack diagrams

Unit-III

Conditionals and recursion: Boolean expressions, Logical operators, conditional execution, alternative execution, chained conditionals, Nested conditionals

Unit- IV

Iterations: Reassignment , While statement, square roots, algorithms. Strings- Traversal with a for loop, string slice, searching.

Unit –V

List: Traversing a list , list operators, list slices, Map filter and reduce, looping and dictionaries, Reserve loopup, Dictionaries and lists.

Course outcomes

CO-1: Understand the basic data types and string operations.

CO-2: Understand and apply various function calls in Python.

CO-3: Familiarise and implement boolean expressions, logical operators and executive statements.

CO-4: Execute the Python programme for tree traversals and search problems.

CO-5: Understand and apply the concepts of dictionaries and lists in Python programme.

Text books/ References books

1. Allen B. Downey,Think Python, 2nd Edition, Shroff publishers,2012.
2. Balagurusamy, E, Introduction to computing and problem solving using Python,McGraw Hill,2016.

15CUL501 CULTURAL EDUCATION 2 0 0 2

Objective:

Love is the substratum of life and spirituality. If love is absent life becomes meaningless. In the present world if love is used as the string to connect the beads of values, life becomes precious, rare and beautiful like a fragrant blossom. Values are not to be learned alone. They have to be imbibed into the inner sprit and put into practice. This should happen at the right time when you have vitality and strength, when your hearts are open. The present course in value education is a

humble experience based effort to lead and metamorphosis the students through the process of transformation of their inner self towards achieving the best. Amma's nectarous words of wisdom and acts of love are our guiding principles. Amma's philosophy provides an insight into the vision of our optimistic future.

1. Invocation, Satsang and Question - Answers
2. Values - What are they? Definition, Guiding Principles with examples Sharing own experiences
3. Values - Key to meaningful life. Values in different contexts
4. Personality - Mind, Soul and Consciousness - Q and A. Body-Mind-Intellect and the Inner psyche Experience sharing
5. Psychological Significance of samskara (with eg. From Epics)
6. Indian Heritage and Contribution and Q and A; Indian Ethos and Culture
7. Self Discipline (Evolution and Practice) – Q and A
8. Human Development and Spiritual Growth - Q and A
9. Purpose of Life plus Q and A
10. Cultivating self Development
11. Self effort and Divine Grace - their roles – Q and A; - Vedanta and Creation - Understanding a spiritual Master
12. Dimensions of Spiritual Education; Need for change Lecture – 1; Need for Perfection Lecture - 2
13. How to help others who have achieved less - Man and Nature Q and A, Sharing of experiences

COURSE OUTCOMES

CO1	Understanding Indian culture
CO2	Understanding Indian value system , Human Development and Spiritual Growth
CO3	Learn about Dimensions of Spiritual Education

REFERENCES:

1. Swami AmritaswaroopanandaPuri - Awaken Children (Volume VII and VIII)
2. Swami AmritaswaroopanandaPuri - Amma's Heart
3. Swami RamakrishnandaPuri - Rising Along the Razor's Edge
4. Deepak Chopra - Book 1: Quantum Healing; Book 2: Alpha and Omega of God; Book 3: Seven Spiritual Rules for Success
5. Dr. A. P. J. Abdul Kalam - 1. Ignited Minds 2. Talks (CD)

6. Swami RamakrishnandaPuri - Ultimate Success
7. Swami JnanamritanandaPuri - Upadesamritham (Trans: Malayalam)
8. Vedanta Kesari Publication - Values - Key to a meaningful life
9. Swami Ranganathananda - Eternal values for a changing society
10. David Megginson and Vivien Whitaker - Cultivating Self Development
11. Elizabeth B. Hurlock - Personality Development, Tata McGraw Hill
12. Swami Jagatatmananda - Learn to Live (Vol.1 and 2), RK Ashram, Mylapore

17MAT515 ADVANCED OPTIMIZATION TECHNIQUES 4-0-0-4

Unit 1

Optimization - optimal problem formulation, engineering optimization problems, optimization algorithms, numerical search for optimal solution.

Unit 2

Optimality criteria, bracketing methods - exhaustive search method, bounding phase method - region elimination methods - interval halving, Fibonacci search, golden section search,

Unit 3

Point estimation method - successive quadratic search, gradient based methods, Newton Raphson, bisection method, secant method and cubic search method.

Unit 4

Constrained optimization – Kuhn-Tucker conditions - transformation methods – penalty function method, method of multipliers, cutting plane method, feasible direction method – gradient projection method, Indirect methods – transformation techniques, penalty function method, branch and bound method –Lagrangianmethod.

Unit 5

Integer Programming Problem(IPP) -Gomory's cutting plane algorithm–Mixed IPP–Branch and Bound technique - Dynamic programming problem (DPP) -Bellman's principle of optimality -General formulation -computation methods and application of DPP-Solving LPP through DPP approach.

Course Outcomes

CO1. Understand different types of Optimization Techniques in engineering problems. Learn Optimization methods such as Bracketing methods, Region elimination methods,Point estimation methods.
CO2. Learn gradient based Optimizations Techniques in single variables as well as multi-variables (non-linear).
CO3. Understand the Optimality criteria for functions in several variables and learn to apply OT methods like Unidirectional search and Direct search methods.
CO4. Learn constrained optimization techniques. Learn to verify Kuhn-Tucker conditions and Lagrangian Method.
CO5. Understand and solve the integer linear programming and dynamic programming.

Text Books

1. HamdyA.Taha(1987):OperationsResearch– An Introduction, 4/e, Prentice Hall of India ,Private Ltd, NewDelhi.
2. KantiSwarup ,P .K .Gupta and ManMohan(2004):Operations Research, Sultan Chand and Sons, New Delhi.

References

1. Kapoor V.K.(2008):OperationsResearch,8/e,SultanChand&Sons

17MAT516 DESIGN OF EXPERIMENTS 4-0-0-4

Unit I

Linear estimation: standard Gauss Markov set up, method of least squares, best linear unbiased Estimators, Gauss – Markov Theorem, Tests of linear hypotheses.

Unit II

Planning of experiments, Basic principles of experimental design, uniformity trails, analysis of variance, one-way, two-way and three-way classification models, completely randomized design (CRD), randomized block design (RBD) Latin square design (LSD) and Graeco-Latin square designs, Analysis of covariance (ANCOVA), ANCOVA with one concomitant variable in CRD and RBD.

Unit III

Factorial experiments, 2^n and 3^n factorial experiments, analysis of 2^2, 2^3 and 3^2 factorial experiments, Yates procedure, confounding in factorial experiments, fractional factorial design.

Unit IV

Response surface designs – Introduction to response surface methodology ,Method of steepest accent, Models properties and Analysis.Analysis of second order response surface,experimental design for fitting response surfaces.

Unit -V

Taguchi methods: Meaning of Quality, Taguchi's loss function, Introduction to orthogonal arrays – test strategies,steps in designing , conducting and analyzing an experiment, parameter and tolerance design : control and noise factors, signal to noise ratios, experimental design in Taguchi Methods,orthogonal arrays and parameter Design.

Course Outcomes

CO1 To understand and develop linear hypotheses

CO2 To develop experiments and apply analysis methods

CO3 To construct factorial experiments and make real time applications

CO4 To analyze experimental outcomes using response surface methodology

CO5 To understand and apply Taguchi experiments

Text books

1. *Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.*
2. *Philip J. Ross : Taguchi's Techniques for quality Engineering , MaGraw-Hill , 1989.*

Reference Books:

1. *Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.*

17MAT517 INTRODUCTION TO DATA SCIENCE 4-0-0-4

Unit I

Big Data Overview, Data Structures, Analyst Perspective on Data Repositories, State of the Practice in Analytics , Current Analytical Architecture, Emerging Big Data Ecosystem and a New Approach to Analytics, Examples of Big Data Analytics

Unit -II

Data Analytics Lifecycle Overview,Data Preparation,Model Planning ,Model Building,Communicate Results ,Case studies, Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation .

Unit III

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

Unit IV

Algorithms for Massive data problems, Clustering ,CURE algorithm –ROCK algorithm -The Chameleon Algorithm – DBSCAN Algorithm --DENCLUE Algorithm –Clustering algorithms for high dimensional data ,Graphical models, Belief propagation, Sparse models.

Unit V

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop Map Reduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

Course Outcomes

CO1 To understand the basic concepts of big data
CO2 To gain knowledge on data preparation model building and exploring
CO3 To understand various machine learning techniques
CO4 To understand various clustering algorithms
CO5 To understand Hadoop Map Reduce Programs

Text books/ References

1. 1.Data Science and big data analytics : Discovering, analyzing , visualizing and presentating data ,EMC Education Services,John Wiley 2015

2. John Hopcroft and Ravi Kannan, “Foundations of Data Science”, ebook, Publisher, 2013.
3. Kevin P. Murphey, “Machine Learning, a Probabilistic Perspective”, The MIT Press, Cambridge, Massachusetts, 2012.

17MAT518 STATISTICAL QUALITY CONTROL 4-0-0-4

Unit I

Basic concept of quality control, process control and product control, seven SPC tools flowchart. Histogram, Check sheet, Ishikawa diagram, Pareto chart, Defect concentration diagram, control chart.Quality and quality assurance, Methods of quality assurance, Introduction to TQM and ISO 9000 standards,

Unit II

Statistical process control, theory of control charts, Shewhart control charts for variables-$\bar{}$, R, s charts, attribute control charts - p, np, c, u charts, modified control charts.

Unit III

OC and ARL curves of control charts, moving average control charts, EWMA charts, CUSUM charts, – two sided and one sided procedures – V – mask technique, process capability analysis, process capability indices – C_p and C_{pk}

Unit IV

Acceptance sampling for attributes, single sampling, double sampling, multiple sampling and sequential sampling plans, rectifying inspection plans, measuring performance of the sampling plans- OC, AOQ, ASN, ATI curves.

Unit V

Acceptance sampling plans by variables, designing a variable sampling plan with a specified OC curve, sampling plan for a single specification limit with known and unknown variance. Sampling plans with double specification limits, Comparison of sampling plans by variables and attributes, Continuous sampling plans.

Course Outcomes

CO1 To understand the basic concepts of quality control and its applications

CO2 To construct variable and attribute control charts and apply the same to process data

CO3 To understand and construct EWMA and CUSUM charts and analyse the process capability

CO4 To gain knowledge about acceptance sampling methods and their properties

CO5 To apply acceptance sampling methods

Text Books:

1. Montgomery D. C. (2005) Introduction to Statistical Quality control, 5th edition, Wiley.
2. Schilling E. G. (1982) Acceptance Sampling in Quality Control, Marcel Decker.

References:

Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

17MAT519 STATISTICAL TESTING OF HYPOTHSIS 4-0-0-4

Unit I

Introduction - relation between confidence intervals and testing of hypothesis – level of significance, critical region and p-value – test statistics and steps for testing of hypothesis – classification of hypothesis tests

Unit II

Large sample tests based on normal distribution – tests for single mean, difference of two means, single proportion, two proportions.

Unit III

Small sample tests - tests for single mean and difference of two means, F – test for equality of two variances - Chi-square based tests – test for independence of attributes and test for goodness - of- fit -

Unit-IV

Sequential Testing, Sequential Probability Ratio Test (SPRT) : Definitions, Properties of the SPRT, Estimation , Examples of the SPRT.

Unit-V

Sign Test, Wilcoxon Signed Rank Test,Mann-Whitney U test; Spearman rank correlation coefficient, Kruskal-Wallis Test, Friedman Test, McNemar's Test.

Course Outcomes

CO1 To understand the formulation of hypothesis testing

CO2 To apply large sample tests for one and two means and proportions

CO3 To apply small sample tests for means and variances

CO4 To gain knowledge and apply SPRT with examples

CO 5 To understand and apply types of nonparametric tests

Text books

1. Rao C.R (1974) Linear Statistical Inference and its Applications, John Wiley, New York.

References

1. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

15AVP501 AMRITA VALUES PROGRAMME 1 0 0 1

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world. Post-graduate students shall have to register for any one of the following courses, in the second semester, which may be offered by the respective school.

Courses offered under the framework of Amrita Values Programme:

Art of Living through Amma

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Insights from the Ramayana

Historical significance of Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Misinterpretation of Ramayana by Colonial powers and its impact on Indian life - Relevance of Ramayana for modern times.

Insights from the Mahabharata

Historical significance of Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance – Importance of Dharma in society – Message of the Bhagavad Gita - Relevance of Mahabharata for modern times.

Insights from the Upanishads

Introduction: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different modes of consciousness - Sanatana Dharma and its uniqueness - The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala,
Aruni, Shvetaketu.

Insights from Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Idea of the Self and Realisation of the Self – Qualities of a Realised person - Concept of Avatar - Relevance of Mahabharata for modern times.

Swami Vivekananda and his Message

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message to Indians about our duties to the nation.

Great Spiritual Teachers of India

Sri Rama, Sri Krishna, Sri Buddha, AdiShankaracharya, Sri Ramanujacharya, Sri Madhvacharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi

Indian Arts and Literature:

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre, Paintings, Sculpture and architecture – the wonder language, Sanskrit and ancient Indian Literature

Importance of Yoga and Meditation in Life:

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Appreciation of Kerala's Mural Art Forms:

A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. A distinguishing characteristic of mural painting is that the architectural elements of the given space are harmoniously incorporated into the picture. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries CE when this form of art enjoyed Royal patronage. Learning Mural painting through the theory
and practice workshop is the objective of this course.

Practicing Organic Farming

Life and nature are closely linked through the healthy practices of society for maintaining sustainability. When modern technological knowhow on microorganisms is applied in farming using the traditional practices we can avoid damage to the environment. The course will train the youth on modern practices of organic farming. Amma says "we have to return this land to the coming generations without allowing even the slightest damage to happen to it". Putting this philosophy to practice will bring about an awakening and enthusiasm in all to strive for good health and to restore the harmony in nature"

Ancient Indian Science and Technology

Science and technology in ancient and medieval India covered all the major branches of human knowledge and activities, including mathematics, astronomy, physics, chemistry, medical science and surgery, fine arts, mechanical, civil engineering, architecture, shipbuilding and navigation. Ancient India was a land of sages, saints and seers as well as a land of scholars and scientists. The course gives an awareness on India's contribution to science and technology.

COURSE OUTCOMES

CO1 Understanding Indian Value system
CO2 Learning for Indian historical epics
CO3 Understanding the importance of Yoga ,Meditation in Life and organic farming.

17MAT606 ALGORITHMS FOR ADVANCED COMPUTING 3-0-1-4

Unit I

Issues regarding classification and prediction, Bayesian Classification, Classification by backpropagation, Classification based on concepts from association rule mining, Other Classification Methods, Classification accuracy.

Unit II

Introduction to Decision trees - Classification by decision tree induction – Various types of pruning methods – Comparison of pruning methods – Issues in decision trees – Decision Tree Inducers – Decision Tree extensions.

Unit III

Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction

Unit IV

Soft Computing: Rationale, motivations, needs, basics: examples of applications in diverse fields, Basic tools of soft computing: Neural Networks, Fuzzy Logic Systems, and Support Vector Machines, Statistical Approaches to Regression and Classification - Risk Minimization, Support Vector Machine Algorithms.

Unit V

Single-Layer Networks: The Perceptron, The Adaptive Linear Neuron (Adaline) and the Least Mean Square Algorithm - Multilayer Perceptrons: The Error Backpropagation Algorithm – The Generalized Delta Rule, Heuristics or Practical Aspects of the Error Backpropagation Algorithm.

Course Outcomes

CO-1: To understand various types of classifications.

CO-2: To familiarize the concepts of decision trees and their applications.

CO-3: To understand the basis of clustering and information extraction.

CO-4: To familiarize various soft computing techniques.

CO-5: To understand the basic networks and network algorithms.

Textbooks

1. Jiawei Han and MichelineKamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann Publishers, 3rd ed, 2010.

2. Jared Dean, “Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners”, Wiley India Private Limited, 2014.

References

1. LiorRokach and OdedMaimon, “Data Mining and Knowledge Discovery Handbook”, Springer, 2nd edition, 2010.
2. Ronen Feldman and James Sanger, “The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data”, Cambridge University Press, 2006.
3. Vojislav Kecman, “Learning and Soft Computing”, MIT Press, 2010.

17MAT607 BIG DATA ANALYTICS 3-0-1-4

Unit I

Big Data and its Importance – Drivers for Big Data — Big Data Analytics applications.

Unit II

Hadoop’s Parallel World – Data discovery – Open source technology for Big Data Analytics – cloud and Big Data – Predictive Analytics – Mobile Business Intelligence and Big Data – Crowd Sourcing Analytics – Inter- and Trans-Firewall Analytics - Information Management.

Unit III

Integrating disparate data stores - Mapping data to the programming framework - Connecting and extracting data from storage - Transforming data for processing - Subdividing data in preparation for Hadoop Map Reduce.

Unit IV

MapReduce, A Weather Dataset, Analyzing the Data with Hadoop, Scaling Out, Hadoop Streaming .

Unit V

The Design of HDFS, HDFS Concepts, Blocks, Command-Line Interface, Reading Data from a Hadoop URL, Writing Data, Deleting Data, Data Flow.

Course Outcomes

CO 1 To gain knowledge on basic concepts of Big Data
CO 2 To understand the tools for applications in Big Data
CO 3 To understand the preparation for Hadoop map reduce
CO 4 To analyse data using Hadoop
CO 5 To understand the organization of data using Hadoop

Text Books/References

1. Michael Minelli, Michele Chambers, and Ambiga Dhiraj, Big data, big analytics : emerging business intelligence and analytic trends for today’s businesses, John Wiley & Sons,2013.
2. Tom White , Hadoop: The Definitive Guide, Fourth Edition , O’Reilly Media ,2009.

17MAT608 MULTIVARIATE STATISTICS FOR DATA ANALYTICS 3-0-1-4

Unit-I:

Multivatiate normal density and its properties - Definition of Wishart matrix and its properties, Mahalanobis Distance, Null distribution of Hotelling's T^2 statistic. Sampling distribution of $\overline{X}$ and S , Large sample behavior of $\overline{X}$ and S ,Assessing the assumption of Normality, Detecting outliers and cleaning data, Transformations to near Normality.

Unit-II:

Separation and classification for two populations, classification with two multivariate normal populations, Fisher's discriminant functions for discriminating several population.

Unit-III:

Principal components, Dimension reduction, Canonical variables and canonical correlation -definition, use, estimation and computation.

Unit-IV:

Factor Analysis: The orthogonal factor model, Methods of estimating factor loadings - the principal component method, principal factor method, iterated principal factor method, maximum likelihood estimation. Factor rotation: orthogonal factor rotation, varimax rotation, quartimax rotation, oblique rotation, criteria for determining number of common factors. Factor scores.

Unit-V:

Cluster Analysis: Hierarchical Clustering, methods single, complete and average linkage methods, Centroid method and Ward's method.Non-Hierarchical Methods- K-means algorithm. Multidimensional scaling.

Course Outcomes

CO 1 To get in-depth knowledge about multivariate distribution
CO2 Classification of populations using discriminant functions
CO3 To understand dimensionality reduction methods and their applications
CO4 To understand and apply factor analysis techniques
CO5 To apply various cluster analysis methods

Text Books

Johnson, R and Wichern(1992): Applied Multivariate Statistical Analysis, Prentice Hall, India, 6th edition.

References

Anderson, T. W. (1983): An Introduction to Multivariate Statistical Analysis. 3rdEd. Wiley.

15MAT651 QUEUING THEORY AND INVENTORY CONTROL THEORY 3-0-0-3

Unit I

Characteristics of Queuing Systems, Steady state solution of M/M/1 and M/M/C queuing models with Finite and Infinite Capacities .Derivation of M/M/1 model only. Stationary behavior of M/G/1.

Unit II

Inventory concept – Components of Inventory model,Deterministic Continuous Review model - Deterministic Periodic Review model.

Unit III

The classical EOQ – Non zero lead time – EOQ with shortages allowed.

Unit IV

Deterministic Multiechelon Inventory models for supply chain management.

Unit V

A stochastic continuous review model – A stochastic single period model for perishable products.

Course Outcomes

CO1. Understand different types of Queueing models..
CO2. Learn basic concepts of inventory models.
CO3. Understand and apply the EOQ in inventory problems..
CO4. Understand the supply chain management.
CO5. Understand the stochastic review models.

Text Books/References

1. F S Hillier and Gerald J Lieberman, Introduction to Operations research, 8th edition, McGraw Hil ,2000
2. Ravindran, Phillips and Solberg, Operations research Principles and Practice, 2nd Edition, John Wiley & Sons.
3. Gross D. and Harris C. MFundamentals of Queueing Theory', John Wiley & Sons Inc, 2004, Third Edition.
4. KantiSwarup ,P .K .Gupta and ManMohan(2004):Operations Research, Sultan Chand and Sons, New Delhi.

15MAT653 STATISTICAL PATTERN CLASSIFICATIONS 3-0-0-3

Unit I:

Introduction and Bayesian Decision Theory

Introduction – Pattern recognition systems – the design cycle – learning and adaptation – Bayesian decision theory – continuous features – Minimum error rate classification – discriminant functions and decision surfaces – the normal density based discriminant functions.

Unit II:

Maximum-likelihood and Bayesian Parameter Estimation

Maximum likelihood estimation – Bayesian estimation - Bayesian parameter estimation – Gaussian case and general theory – problems of dimensionality – components analysis and discriminants – hidden Markov models.

Unit III:

Nonparametric Techniques and Linear Discriminant Functions

Nonparametric techniques – density estimation – Parzen windows – nearest neighborhood estimation – rules and metrics – linear discriminant functions and decision surfaces – generalized linear discriminant functions – two-category linearly separable case – minimizing the perception criterion function.

Unit IV:

Nonmetric methods and Algorithm-independent Machine Learning

Nonmetric methods – decision trees – CART methods – algorithm-independent machine learning – lack of inherent superiority of any classifier – bias and variance for regression and classification – resampling or estimating statistics – estimating and comparing classifiers.

Unit V:

Unsupervised Learning and Clustering

Unsupervised learning and clustering – mixture densities – maximum likelihood estimates – application to normal mixtures – unsupervised Bayesian learning – data description and clustering – criterion functions for clustering – hierarchical clustering – component analysis – low-dimensional representations and multi-dimensional scaling.

Course Outcomes

CO1 To understand Bayesian decision theory and its use

CO2 To gain knowledge about Bayesian estimation methods

CO3 To apply nonparametric techniques and linear discriminant functions

CO4 To gain knowledge about nonmetric methods and algorithm independent machine learning

CO5 To apply unsupervised learning and clustering

Text Books/References:

1. Richard O. Duda, Peter E. Hart and David G. Stork, *Pattern Classification*, Second Edition, 2003, John Wily & Sons.
2. Earl Gose, Richard Johnsonbaugh and Steve Jost, *Pattern Recognition and Image Analysis*, 2002, Prentice Hall of India.

17MAT650 ADVANCED BIG DATA ANALYTICS 3-0-0-3

Unit - I

How MapReduce Works - Anatomy of a MapReduce Job Run, Failures, Shuffle and Sort, Task Execution

Unit -II

MapReduce Types and Formats - MapReduce Types, Input Formats, output formats,

Unit- III

MapReduce Features- Counters, Sorting, Joins, Side Data Distribution

Unit -IV

Simple analytics using MapReduce, Calculating frequency distributions and sorting using MapReduce, Calculating histograms using MapReduce, Calculating scatter plots using MapReduce

Unit – V

Hierarchical clustering, Clustering algorithm to large dataset, classification using Navie bayes classifier, other applications

Course Outcomes

CO1 To understand the anatomy of MapReduce
CO2 To gain knowledge on MapReduce Types and Formats
CO3 To understand MapReduce Features
CO4 To understand simple analytics using MapReduce and apply
CO5 To understand clustering techniques and its applications

Text Books/References

1. Tom White , Hadoop: The Definitive Guide, Fourth Edition , O'Reilly Media ,2009
2. Srinath Perera and Thilina Gunarathne , Hadoop MapReduce Cookbook : Recipes for analyzing large and complex datasets with Hadoop MapReduce, Packt PublishingLtd,2013.

17MAT657 DATA ANALYSIS IN BIOLOGY 3-0-0-3

Unit-I

Introduction and Bioinformatics Resources: Knowledge of various databases and bioinformatics tools available at these resources, the major content of the databases, Literature databases:
Nucleic acid sequence databases: GenBank, EMBL, DDBJ Protein sequence databases: SWISS-PROT, TrEMBL, PIR, PDBGenome Databases at NCBI, EBI, TIGR, SANGER .Other Databases of Patterns/Motifs/System Biology (Gene and protein network database and resources)

Unit- II

Sequence analysis:• Various file formats for bio-molecular sequences: GenBank, FAST,etc. Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues. Scoring matrices: basic concept of a scoring matrix, PAM and BLOSUM series. Sequence-based Database Searches: what are sequence -based database searches, BLAST and FASTA algorithms, various versions of basic BLAST and FASTA.

Unit-III

Pairwise and Multiple sequence alignments: basic concepts of sequence alignment, Needleman &Wuncsh, Smith & Waterman algorithms for pairwise alignments, Progressive and hierarchical algorithms for MSA. Use of pairwise alignments and Multiple sequence alignment for analysis of Nucleic acid and protein sequences and interpretation of results.

Unit-IV

Phylogeny: Phylogenetic analysis, Definition and description of phylogenetic trees and various types of trees, Method of construction of Phylogenetic trees [distance based method (UPGMA, NJ), Maximum Parsimony and Maximum Likelihood method

Unit -V

Current Advancements in Bioinformatics:Introduction to Structural bioinformatics and Chemoinformatics.

Course Outcomes

CO1 To understand and apply various bioinformatics database tools.
CO2 To gain knowledge on sequence analysis and its application.
CO3 To understand and apply pairwise and multiple sequence alignments.
CO4 To understand the construction of phylogenetic trees
CO5 To understand the structural bioinformatics and chemoinformatics.

Text Books/References

1. Ingvar Eidhammer, Inge Jonassen, William R. Taylor John Wiley: Protein bioinformatics; an algorithmic approach to sequence and structure analysis ,John Wiley,New Delhi,2003.
2. Higgins,Des and Taylor Williw: Bioinformatics: Sequence , Structure and databanks, Oxford , University Press,2000.
3. Leach Andrew R and Gillet Valerie J: An introduction to Chemoinformatics, Springer,NewDelhi,2007

17MAT658 MARKETING ANALYTICS 3-0-0-3

Unit I

Probability Theory : Experiments, Outcomes, Probability, conditional probability and Bayes Theorem. Random Variables and Probability Distributions -Mean and Variance of a Distribution, Binomial, Poisson and Normal Distributions.

Unit II

Random processes:General concepts and definitions - stationary in random processes - strict sense and wide sense stationary processes - autocorrelation and properties- special processes – Poisson points, Poisson and Gaussian processes and properties.

Unit III

Systems with stochastic inputs - power spectrum- spectrum estimation, ergodicity –Markov process and Markov chain, transition probabilities, Chapman Kolmogrov theorem, limiting distributions classification of states.

Unit IV

Time series as a discrete parameter stochastic process, Auto - covariance, Auto-correlation functions and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, forecasting based on smoothing.

Unit-V

Linear time series models: Autoregressive, Moving Average, autoregressive Moving Average models, Autoregressive Integrated Moving Average models. Estimation of ARMA models: Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARMA Processes.

Course Outcomes

CO1 To understand the application of probability theory and distributions

CO2 To gain knowledge about random process and autocorrelation functions

CO3 To understand spectrum estimation and Markov process for their applications

CO4 To understand the concept of time series and properties

CO5 To apply various time series models

Text Books

1. *J*. Ravichandran, "Probability and Random Processes for Engineers", First Edition, IK International, 2015
2. Anderson, T.W. The Statistical Analysis of Time Series, John Wiley, New York, 1971.
3. Box, G.E.P. and Jenkins, G.M. Time Series Analysis- Forecasting and Control, Holden-day, San Francisco,1976.

References

1. A. Papoulis and Unnikrishna Pillai, "Probability, Random Variables and Stochastic processes", Fourth Edition, McGraw Hill, 2002.
2. Kendall, Sir Maurice and Ord, J.K., Time Series, Edward Arnold, London, 1990.

17MAT659 REGRESSION ANALYSIS 3-0-0-3

Unit I

Simple Linear Regression: Simple Linear Regression Model, Least square estimation of the parameters , Hypothesis Testing on the slope and internet, Interval estimation in Simple linear Regression, Prediction of New Observations , Coefficient of Determination, Regression through origin, Estimation by Maximum Likelihood.

Unit II

Multiple Linear Regression: Multiple Linear Regression Models, Estimation of the Model Parameters, Hypothesis testing in Multiple Linear Regression, Confidence Interval on the Regression, Prediction of New observations, Hidden Extrapolation in Multiple Regression.

Unit III

Model Adequacy Checking: Introduction, Residual Analysis, The PRESS Statistic, Detection and treatment of Outliers, Lack of fit of the Regression Model.

Unit IV

Polynomial Regression Models: Introduction, Polynomial Models in One Variable, Nonparametric Regression, Polynomial Models in Two or More Variables, Orthogonal Polynomials.

Unit V

Variable Selection and Model Building: Introduction, Computational Techniques for Variable Selection.

Nonlinear Regression : Linear and Nonlinear Models, Nonlinear Least squares, Transformation to a linear Model ,Parameter Estimation in a Nonlinear System, Examples of Nonlinear Regression Models.

Course Outcomes

CO 1 To understand simple linear regression models and its use for data analysis

CO 2 To understand multiple linear regression models and its use for data analysis

CO 3 To understand the importance of model adequacy checks

CO 4 To apply polynomial regression models for data analysis

CO 5 To understand nonlinear regression variable selection techniques in regression analyses

Text Books/References

1. Douglas C. Montgomery and Elizabeth A.Peck and G.Geoffrey Vining, Introduction to Linear Regression Analysis",3rd Edition ,John Wiley& Sons, Inc
2. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012

17MAT660 RELIABILITY THEORY 3-0-0-3

Unit - I

Introduction to Reliability and its needs; Different Approaches to Reliability Analysis, Application Areas, State Variable, Time to Failure, Failure Rate Function, Mean Time to Failure,Relationship between the Functions F(t), f'(t), R(t), and z(t) , Bath tub cuvrve, Mean time to failure, Residual time

Unit -II

Parametric families of some common life distributions –Exponential, Weibull and Gamma and its characterization-Reliability estimation of parameters in these models.

Unit III

Qualitative System Analysis, Systems and Interfaces,Functional Analysis,Failures and Failure Classification,Failure Modes, Effects, and Criticality Analysis, Fault Tree Analysis, Cause and Effect Diagrams,Bayesian Belief Networks, Event Tree Analysis,Reliability Block Diagrams.

Unit -IV

Systems of Independent Components -System Reliability,Nonrepairable Systems,Quantitative Fault Tree Analysis

Unit-V

Reliability of Maintained Systems -Types of Maintenance, Downtime and Downtime Distributions,System Availability Assessment

Course Outcomes

CO 1 To gain knowledge about reliability analysis and methods
CO 2 To apply various reliability distributions to real time examples
CO 3 To understand and analyze reliability data using various methods
CO 4 To analyze reliability data on system dependent compoents
CO 5 To gain knowledge about down time and maintenance data and analysis

Text Books/References

1. Marvin Rausand and ArnljotHoyland ,(2003): System Reliability Theory : Models , Statistical methods and applications ,2nd edition ,John wiley and Sons Inc., publications.
2. Balagurusamy,E , Reliability Engineering, ata McGraw-Hill Education, 1984.

17MAT670 SIX SIGMA QUALITY ANALYSIS 3-0-0-3

Unit 1

Introduction to Quality Management – Japanese System of Total Quality Management.

Unit 2

Quality Circles - 7 Quality Control tools - 7 New Quality Control tools.

Unit 3

ISO 9000 Quality system Standards - Project Planning, Process and measurement system capability analysis - Area properties of Normal distribution.

Unit 4

Metrics of Six sigma, The DMAIC cycle - Design for Six Sigma - Lean Sigma – Statistical tools for Six Sigma.

Unit 5

Taguchi methods. Loss functions and orthogonal arrays and experiments.

Course Outcomes

CO 1 To understand the concept of quality management

CO 2 To apply the new and old quality control tools

CO 3 To gain knowledge about quality system standards and processes

CO 4 To understand the concept of Six Sigma and Lean Sigma

CO 5 To apply Taguchi methods

Text Books

1. Ravichandran. J, Probability and Statistics for Engineers, 1st Edition 2012 (Reprint), Wiley India.
2. Taguchi G, Introduction to Quality Engineering: Designing Quality into Products and Processes Second Edition, 1991.

References

1. Montgomery Douglas C., Introduction to Statistical Quality Control, Sixth Edition. John Wiley & Sons, (2008).
2. Ishikawa K., Guide to Quality Control, 2nd Edition: Asian Productivity Organization, Tokyo (1983).
3. Harry, M and Schroeder R., Six Sigma: The Breakthrough Management Strategy. Currency Publishers, USA. (2000).