Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Mathematics(Minor for CS)

Title of the Course: Applied Mathematical Science I								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
MNR-3	BS-MS-201T	03	00	03	60	30	70	**100**

Learning Objectives:

1. To understand mathematical reasoning in order to read, comprehend and construct Mathematical arguments as well as to solve problems.
2. To work with discrete structures such as graphs to study the structure of the world wide web, to model a computer network and to find the shortest path between two places in a transportation network.

3. Discuss basic ideas of linear regression and correlation.

4.Create and analyze scatter plots.

5 Create and interpret a line of best fit.

Course Outcomes (Cos)

1. Apply logical reasoning to solve a variety of problems.
2. Solve discrete probability problems.
3. Learn the relationship between sequences and recurrence relations.
4. To build the necessary skill for developing computer-based solutions using mathematical concepts.
5. Understand the concept correlation and regression for ungrouped data.
6. Know about the different type of data like univariate, bivariate data etc.
7. Understand how to generate time series &its graphical method.

Details of Syllabus:

SECTION I: Discrete Mathematics

Unit 1: Logic and Relations **[12 Lectures]**

1.1 Propositional Logic

1.2 Propositional Equivalences.

1.3 Relations, Type of Relations, equivalence relation, Partial order relation.

1.4 Digraphs of relations, matrix representation and composition of relations.

1.5 Transitive closure and Warshall's Algorithm.

1.6 Poset, Hasse diagram

Unit 2: Counting Principles [09 Lectures]

2.1 Cardinality of Set: Cardinality of a finite set.

2.2 Basics of Counting: The Product Rule, The Sum Rule, The Inclusion-Exclusion Principle.

2.3 The Pigeonhole Principle: Statement, The generalized Pigeonhole Principle

2.4 Generalized Permutations and Combinations: Permutation and Combination with

2.5 Repetitions, Permutation with Indistinguishable Objects.

Unit 3: Recurrence Relations [09 Lectures]

3.1 Recurrence Relation: Introduction

3.2 Linear Recurrence Relations with constant coefficients.

3.3 Homogeneous Solutions.

3.4 Particular Solutions.

3.5 Total Solutions

SECTION II: Methods of Applied Statistics.

Unit 4: Correlation And Regression (For Ungrouped Data) Multiple Regression And Multiple ,Partial Correlation (For Trivariate Data): [25 Lectures]

3.1 Concept of bivariate data, scatter diagram, its interpretation, concept of correlation,Positive correlation, negative correlation, zero correlation.

3.2 Karl Pearson's coefficient of correlation, properties of correlation coefficient, Interpretation of correlation

3.3 coefficient, coefficient of determination with interpretation.

3.4 Spearman's rank correlation coefficient (formula with and without ties).

3.5 Concept of linear and nonlinear regression., Illustrations, appropriate situations for regression and correlation.

3.6 Linear regression: Fitting of both lines of regression using least square method.

3.7 Concept of regression coefficients. 2.5 Properties of regression coefficients: $bxy \cdot byx = r2$, $bxy * byx \leq 1$, $bxy = r(\sigma x / \sigma y)$ and $byx = r(\sigma y / \sigma x)$.

3.8 Nonlinear regression models: Second degree curve, exponential curves of the type $Y=ab^x$ and $Y=a^xb$.

3.9 Concept of multiple regressions, Yule's Notations.

3.10 Fitting of multiple regression planes. [Derivation of equation to the plane of regression of

3.11 X1 on X2 and X3 is expected. Remaining two equations to be written analogously.]

3.12 Concept of partial regression coefficients, interpretations.

3.13 Concept of multiple correlation: Definition of multiple correlation coefficient and its formula.

Concept of partial correlation. Definition of partial correlation coefficient and its formula Numerical problems related to real life situations.

Unit 5: Time Series **[05 Lectures]**

4.1 Meaning and utility.
4.2 Components of time series.
4.3 Additive and multiplicative models.
4.4 4Methods of estimating trend: moving average method, least squares method and exponential smoothing method (with graph and interpretation).
4.5 Numerical problems related to real life situations

Unit 6: Tutorial:

6.1 Linear correlation and regression (use of scatter plot for explaining the linear relationship between two variables).
6.2 Fitting of non-linear regression. (use of scatter plot for explaining the non-linear relationship between two variablesTime Series- Estimation of trend by using the method of moving averages

Suggested Readings:

1. Discrete Mathematics and it's applications, by Kenneth Rosen, TataMc-Graw Hill, Seventh Edition
2. Discrete Mathematical Structure, by Kolman, Busby, Rehman,Prentice Hall,Pearson Education, 5th edition.
3. Elements of Discrete Mathematics, by C. L. Liu, Tata Mc-Graw Hill
4. Discrete Mathematics, 8th Edition by Richard Johnsonbaugh ,Pearson
5. Discrete mathematical structures, G. Shanker Rao, New Ageinternational (P) Limited, Publishers
6. Introduction to Linear Regression Analysis, Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley
7. Time Series Analysis,4th Edition, Box and Jenkin, Wiley, 2008
8. Fundamentals of Applied Statistics(3rd Edition), Gupta and Kapoor, S. Chand and Sons,New Delhi, 1987
9. Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). The World Press Pvt. Ltd., Calcutta

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New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus

B.Sc. Mathematics(Minor)

Title of the Course: Applied Mathematical Science II								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
MNR-4	BS-MS-202T	03	00	03	60	30	70	**100**

Learning Objectives:

1. Introduce the students to graphs, their properties and their applications as models of networks.
2. Represent almost any physical situation involving discrete objects and a relationship among them.
3. Introduce the students to generating functions and their applications.
4. Understand fundamentals of graph theory.
5. Demonstrate knowledge of probability and the standard statistical distributions.
6. Demonstrate knowledge of fixed-sample and large-sample statistical properties of point and interval estimators.
7. Demonstrate knowledge of the properties of parametric, testing procedures.

Course Outcomes (Cos):

1. Students will apply the algorithms that are treated in the course for solving graph theoretical problems.
2. Students are able to use graph theory as a modelling tool.
3. Understand the concept correlation and regression for ungrouped data.
4. Know about the different type of data like univariate, bivariate data etc.
5. Understand how to generate time series &its graphical method.

Details of Syllabus:

SECTION I: Graph Theory

Unit 1: An Introduction to Graph: [08 Lectures]

1.1 Definitions, Basic terminologies and properties of graph, Graphmodels.

1.2 Special types of graphs, Basic terminologies, properties andexamples of directed graphs, Types of Digraphs.

1.3 Some applications of special types of graphs.

1.4 Matrix representation and elementary results, Isomorphism ofgraphs.

Unit 2: Connected Graph: [07 Lectures]

2.1 Walk, Trail, Path, Cycle, elementary properties of connectedness,Counting pathsbetween vertices (by Warshall's Algorithm).

2.2 Cut Edge (Bridge), Cut Vertex, Cut Set, Vertex Connectivity,Edge Connectivity and Properties.

2.3 Shortest Path Problem, Dijkstra's Algorithm.

Unit 3: Path and Trees [15 lectures]

3.1 The Konigsberg Seven Bridge Problem, Euler Trail, Path, Circuitand Tour, Elementary Properties and Fleury's Algorithm.

3.2 Hamilton Path, Circuit, elementary Properties and Examples.

3.3 Introduction to Travelling Salesman Problem, Chinese PostmanProblem.

3.4 Definitions, Basic terminologies, Properties, and Applications of Trees.

3.5 Weighted Graph, Definition and Properties of Spanning Tree, Shortest Spanning Tree, Kruskal's Algorithm, Prim's Algorithm.

3.6 M-array Tree, Binary Tree, Definitions and Properties, Tree Traversal: Preorder, Inorder, Postorder, Infix, Perfix, Postfix notations and examples.

Section II: Continuous Probability Distribution and Testing of Hypothesis.

Unit 4: Continuous Random variable and Standard Continuous Probability Distributions: [12 Lectures]

4.1 Definition of random variable (r.v.) , continuous srandom variable.

4.2 Definition of Probability density function of continuous r .v.

4.3 Cumulative distribution function (c.d.f.) of continuous

a. r.v. and their properties. (Characteristic properties only).

4.4 Definition of expectation and variance of discrete and continuousr.v., theorem on

expectation and variance (statement only).

4.8 Uniform Distribution: statement of p.d.f., mean, variance, nature ofprobability curve.Theorem (without proof): The distribution function of any continuous r.v. if it is invertible follows U(0, 1) distribution.

4.9 Exponential Distribution: statement of p.d.f. of the form $f(x) = (1/\theta)\, e(-x/\theta)$, mean,variance, nature of probability curve, lack ofmemory property. (with proof).Parato distribution: Form of pdf $f(x):\alpha/ x^{(\alpha+1)}$; $x \geq 1$, $\alpha > 0$. Mean,variance, symmetry,applications.

4.10 Normal Distribution: statement of p.d.f., identification of parameters, nature of probability density curve, standard normal distribution, symmetry, distribution of a X+b, aX+bY+c where X and Y are independent normal variables, computations of probabilities using normal probability table, normal approximationto binomial and Poisson distribution,central limit theorem (statement only), normal probability plot. Box Muller Transformation.Numerical problems related to real life situations.

Unit 5: Concepts and definitions related to testing of hypothesis and Parametric Tests: [14 Lectures]

5.1 Concepts of population and sample. Definitions: random sample from a probability distribution,parameter, statistic, standard error of estimator.

5.2 Concept of null hypothesis and alternative hypothesis (Research hypothesis), critical region level of significance, type I and type IIerror, one sided and two sided tests, Test of hypothesis, p-value.

5.3 Large Sample Tests:

4.3.1 Ho: $\mu = \mu o$Vs H1: $\mu \neq \mu o$, $\mu < \mu o$, $\mu > \mu o$ (One sided and twosided tests).

4.3.2 Ho: $\mu 1 = \mu 2$ Vs H1: $\mu 1 \neq \mu 2$, $\mu 1 < \mu 2$, $\mu 1 > \mu 2$ (One sidedand two sidedtests).

4.3.3Ho: P = Po Vs H1: $P \neq Po$, $P < Po$, $P > Po$ (One sided andtwo sided tests).

4.3.4Ho: P1 = P2 Vs H1: $P1 \neq P2$, $P1 < P2$, $P1 > P2$ (One sidedand two sidedtests).

4.3.5 Numerical problems related to real life situations.

Tests based on Chi square distribution:

4.3.6 Chi-square test for goodness of fit.

4.3.7 Test for independence of attributes (mxn and 2x2)Numerical problems related to real life situations.

Tests based on t – distribution:

4.5.1 Ho: $\mu 1 = \mu 2$ Vs H1: $\mu 1 \neq \mu 2$, $\mu 1 < \mu 2$, $\mu 1 > \mu 2$ (One sidedand two sided tests).

4.5.2 Paired t-test.Test based on F- distribution:

F-test for testing significance of equality of two population variances.

Unit 6: Simulation: **[4 lectures]**

6.1 Introduction, concept of simulation, random numbers, pseudo random numbers, Advantages, Disadvantages of Simulation. Applications.

6.2 Methods of simulation, Linear congruential generator and simulation from Uniform, Exponential and Normal Distribution

Unit 7: Tutorial:

7.1 Large sample tests.

7.2 Model sampling from continuous uniform, exponential and normal distributions using Excel.

Suggested Readings:

1. Discrete Mathematics and it's applications, by KennethRosen, Tata Mc-Graw Hill, Seventh Edition
2. John Clark and Derek Holton, A first look at Graph Theory,Allied Publishers.
3. Narsingh Deo, Graph Theory with applications to computerscience and engineering, Prentice Hall.
4. C. L. Liu, Elements of Discrete Mathematics, Tata Mc-GrawHill, Fourth Edition.
5. Douglas B. West, Introduction to Graph Theory, PearsonEducation, Second Edition.
6. A First course in Probability, Sheldon Ross.Pearson Education Inc. Statistical Methods (An Introductory Text),Medhi J. 1992 ,NewAgeInternational
7. Probability, Statistics, Design of Experiments and Queuing Theorywith Applications ofComputer Science,Trivedi K.S. 2001,PrenticeHallof India, NewDelhi
8. Gupta S. C.andKapoor V. K.1987 Fundamentals of MathematicalStatistics(3rd Edition)S.Chandand Sons, New Delhi
9. Simulation Modelling and Analysis Law A. M. and Kelton W.D.2007, TataMcGraw Hill.