1.1.3

List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	

List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : *Mathematics*

Programme Name : *B.Sc., MSc., Ph.D.*

Academic Year : 2022-23

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
01.	AMUCTT3	Probability and Statistics
02.	AMUATA2	Basics of Statistics
03.	AMUATL1	Introduction to Cryptography
04.	AMUATL2	Special Function
05.	AMUBTL1	Graph Theory
06.	AMUBTL2	Linear Programming
07.	DSE 2.1	Industrial Mathematics
08.	DSE 2.2	Boolean Algebra and Automata Theory
09.	DSE 2.1	Probability and Statistics
10.	DSE 3.2	Bio-Mathematics
11.	DSE 3.3	Linear Programming
12.	AMPATO1	Applications of Fuzzy Sets & Fuzzy Logic
13.	AMPBTD5	Mathematical Statistics
14.	AMPDTD3	Applications of Fuzzy Logic
15.	AMPDTD5	Cryptography
16.	AMPDTD6	Financial Mathematics and its Applications
17.	AMPDTD8	Operations Research

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GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR

DEPARTMENT OF MATHEMATICS

COURSE STRUCTURE & SYLLABUS-B.Sc. (Hon.) in Mathematics

Sem	Course Type	Course Code	Course Name	Credit/Hours (L-T-P)	Marks CCA^	Marks ESE#	Total Marks
I	CORE 1	AMUATT1	Calculus	5(4-1-0)	30	70	100
	CORE 2	AMUATT2	Algebra and Geometry	5(4-1-0)	30	70	100
	GE-1		Opted from the pool Course and offered by Sister Departments	5	30	70	100
	AEC-1		Opted from the Pool Course offered by University	2	30	70	100
	SEC-1		Opted from the Pool Course offered by University	2	30	70	100
	Additional Credit Course						
			Total Credit	**19**			
II	CORE 3	AMUBTT1	Multivariable Calculus	5(4-1-0)	30	70	100
	CORE 4	AMUBTT2	Ordinary Differential Equations	5(4-1-0)	30	70	100
	GE-2		Opted from the pool Course and offered by Sister Departments	5	30	70	100
	AEC-2		Opted from the Pool Course offered by University	2	30	70	100
	SEC-2		Opted from the Pool Course offered by University	2	30	70	100
	Additional Credit Course						
			Total Credit	**19**			
III	CORE 5	AMUCTT1	Real Analysis	5(4-1-0)	30	70	100
	CORE 6	AMUCTT2	Group Theory	5(4-1-0)	30	70	100
	CORE 7	AMUCTT3	Probability and Statistics	5(4-1-0)	30	70	100
	GE-3		Opted from the pool Course and offered by Sister Departments	5	30	70	100
	AEC-3		Opted from the Pool Course offered by University	2	30	70	100
	Additional Credit Course						
			Total Credit	**22**			

IV	CORE 8	AMUDTT1	Mechanics	5(4-1-0)	30	70	100
	CORE 9	AMUDTT2	Linear Algebra	5(4-1-0)	30	70	100
	CORE 10	AMUDTT3	Partial Differential Equations and Calculus of Variations	5(4-1-0)	30	70	100
	GE-4		Opted from the pool Course and offered by Sister Departments	5	30	70	100
	AEC-4		Opted from the Pool Course offered by University	2	30	70	100
	Internship*	AMUDEF1		06			100
	Additional Credit Course						
			Total Credit	**22+6***			
V	CORE11	AMUETT1	Set Theory and Metric Spaces	5(4-1-0)	30	70	100
	CORE 12	AMUETT2	Advanced Algebra	5(4-1-0)	30	70	100
	DSE (any two)	AMUETD1	Tensors and Differential Geometry	5(4-1-0)	30	70	100
		AMUETD2	Mathematical Logic	5(4-1-0)	30	70	100
		AMUETD3	Integral Transforms and Fourier Analysis	5(4-1-0)	30	70	100
		AMUETD4	Linear Programming	5(4-1-0)	30	70	100
		AMUETD5	Information Theory and Coding	5(4-1-0)	30	70	100
		AMUETD6	Graph Theory	5(4-1-0)	30	70	100
		AMUETD7	Special Theory and Relativity	5(4-1-0)	30	70	100
	AEC-5		Opted from the Pool Course offered by University	2	30	70	100
	Additional Credit Course						
			Total Credit	**22**			
VI	CORE 13	AMUFTT1	Complex Analysis	5(4-1-0)	30	70	100
	CORE 14	AMUFTT2	Numerical Analysis	5(4-1-0)	30	70	100
	DSE (any one)	AMUFTD1	Discrete Mathematics	5(4-1-0)	30	70	100
		AMUFTD2	Wavelets and Applications	5(4-1-0)	30	70	100
		AMUFTD3	Number Theory	5(4-1-0)	30	70	100

		AMUFTD4	Mathematical Finance	5(4-1-0)	30	70	100
		AMUFTD5	C++Programming for Mathematics	5(4-1-0)	30	70	100
		AMUFTD6	Cryptography	5(4-1-0)	30	70	100
		AMUFTD7	Advanced Mechanics	5(4-1-0)	30	70	100
	Seminar	AMUFST1 ~		02			100
	Dissertation/Project	AMUFDT1 ~		07			100
	Additional Credit Course						
				Total Credit	**24**		

~The Code generated by the Department., *May be offered during the summer;
^ Continuous Comprehensive Assessment (CCA), # End-Semester Examination (ESE)

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Generic Elective (GEN) offered by the Department:

	Course Type	Course Code	Course Name	Credit/Hour(L-T-P)	Marks CCA^	Marks ESE#	Total Marks
1	GE-1 (Any one)	AMUATG1	Finite Element Methods	5(4-1-0)	30	70	100
		AMUATG2	Geometry	5(4-1-0)	30	70	100
2	GE-2 (Any one)	AMUBTG1	Algebra and Matrix Theory	5(4-1-0)	30	70	100
		AMUBTG2		5(4-1-0)	30	70	100
3	GE-3 (Any one)	AMUCTG1	Differential Calculus	5(4-1-0)	30	70	100
		AMUCTG2	History of Indian Mathematics	5(4-1-0)	30	70	100
4	GE-4 (Any one)	AMUDTG1	Applications of Algebra	5(4-1-0)	30	70	100
		AMUDTG2	Combinatorial Mathematics	5(4-1-0)	30	70	100
		AMUDTG3	Theory of Equations	5(4-1-0)	30	70	100

Ability Enhancement Course (AEC) offered by the Department:

	Course Type	Course Code	Course Name	Credit/Hour (L-T-P)	Marks CCA^	Marks ESE#	Total Marks
1	AEC-1 (Any one)	AMUATA1	Set Theory and Logic	2(2-0-0)	30	70	100
		AMUATA2	Basics of Statistics	2(2-0-0)	30	70	100
2	AEC-2 (Any one)	AMUBTA1	Theory of Interpolation	2(2-0-0)	30	70	100
		AMUBTA2		2(2-0-0)	30	70	100
3	AEC-3 (Any one)	AMUCTA1	Curve Tracing	2(2-0-0)	30	70	100
		AMUCTA2		2(2-0-0)	30	70	100
4	AEC-4 (Any one)	AMUDTA1	Matrix and Determinant	2(2-0-0)	30	70	100
		AMUDTA2		2(2-0-0)	30	70	100
5	AEC-5 (Any one)	AMUETA1	Integral Transform	2(2-0-0)	30	70	100
		AMUETA2					

Skill Enhancement Course (SEC) offered by the Department:

	Course Type	Course Code	Course Name	Credit/Hour (L-T-P)	Marks CCA^	Marks ESE#	Total Marks
1	SEC-1 (Any one)	AMUATL1	Introduction to Cryptography	2(2-0-0)	30	70	100
		AMUATL2	Special Function	2(2-0-0)	30	70	100
2	SEC-2 (Any one)	AMUBTL1	Graph Theory	2(2-0-0)	30	70	100
		AMUBTL2	Linear Programming	2(2-0-0)	30	70	100

L-Lecture, T- Tutorial, P- Practical

B.Sc. (Honours) in Mathematics

(Syllabus approved by Board of Studies meeting on 11.07.2018)

Department of Pure & Applied Mathematics

School of Mathematical and Computational Sciences

UNDER THE

CHOICE BASED CREDIT SYSTEM (CBCS)

11/07/18 (P.P. MURTHY)

11/07/18 (A.K. SRIVASTAVA)

SCHEME OF EXAMINATION

All papers of B.Sc.(Honors'in Mathematics) **First, Second, Third** and **Fourth** Semesters are compulsory. In **Fifth** and **Sixth** Semesters **TWO PAPERS(02)** are **core papers** and each student has to choose three papers from the list of given **optional papers**. An examinee has to attempt total five (05) questions out of eight(08) i.e. one compulsory and four optional. Question No. 1 is compulsory and will consist of short answered type ten(10) questions spread all over the syllabus carrying 20 marks (2 marks of each question). Rest of all questions will carry 10 marks each.

In addition to this in the final semester (i.e. Fourth Semester of M.Sc. in Mathematics) a student can choose **two optional papers** and one **project dissertation (selection based on the criteria fixed by Department Head)** under the supervision/guidance of any of the faculty members in the relevant areas of Mathematics closely to the subjects taught at M.Sc. level. Supervisor and topic of the dissertation for student is being allotted at the level of Department in consultation with HOD by a team of faculty members. The dissertation evaluation of 100 marks is evaluated by a committee **consisting of HOD, supervisor and external subject expert**. Each paper (except project dissertation) is of 100 marks and its distribution is as under:

Internal Assessment: **40** (30 marks of internal examination + 05 marks of assignment + 05 maximum marks on attendance)

End Semester Examination: 60

B.Sc. (Hon's) in Mathematics				
Semester	**Course Type**	**Course Code**	**Course Name**	**Credit/ Hours**
I	Core	C1.1	Calculus (Theory)	04
		C 1.1	Practical (Lab)	02
		C 1.2	Algebra	06
	Generic Elective	GE 1.1	Differential Calculus	06
		GE 1.2	Object Oriented Programming in C++	06
		GE 1.3	Finite Element Methods	06
II	Core	C2.1	Real Analysis	06
		C 2.2	Differential Equations (Theory)	04
		C 2.2	Practical (Lab)	02
	Generic Elective	GE 2.1	Algebra and Matrix Theory	06
		GE 2.2	Mathematical Finance	06
		GE 2.3	Econometrics	06
	Core	C3.1	Theory of Real Functions	06
		C3.2	Group Theory I	06
		C3.3	PDE and System of ODE (Theory)	04
		C3.3	Practical (Lab)	02
		GE 3.1	Ordinary Differential Equations	06

III	Generic Elective		and Vector Calculus	
		GE 3.2	Cryptography and Network Security	06
		GE 3.3	Information Security	06
	SEC	SEC 1.1	Logic and Sets	06
		SEC 1.2	Computer Graphics	06
IV	Core	C4.1	Numerical Methods (Theory)	04
		C4.1	Practical (Lab)	02
		C4.2	Riemann Integration and series of Functions	06
		C4.3	Ring Theory and Linier Algebra I	06
	Generic Elective	GE4.1	Partial Differential Equations, Laplace Transform and Fourier Series	06
		GE 4.2	Applications of Algebra	06
		GE 4.3	Combinatorial Mathematics	06
	SEC	SEC 2.1	Graph Theory	06
		SEC 2.2	Operating System: Linux	06
V	Core	C 5.1	Multivariate Calculus	06
		C 5.2	Group Theory II	06
	DSE (Any One)	DSE 1.1	Portfolio Optimization	06
		DSE 1.2	Number Theory	06
		DSE 1.3	Analytical Geometry	06
	DSE (Any One)	DSE 2.1	Industrial Mathematics	06
		DSE 2.2	Boolean Algebra and Automata Theory	06
		DSE 2.3	Probability and Statistics	06
VI	Core	C 6.1	Metric Space and Complex Analysis	06
		C 6.2	Ring Theory and Linear Algebra II	06
	DSE (Any One)	DSE 3.1	Theory of Equations	06
		DSE 3.2	Bio-Mathematics	06
		DSE 3.3	Linear Programming	06
	DSE (Any One)	DSE 4.1	Mathematical Modeling	06
		DSE 4.2	Mechanics	06
		DSE 4.3	Differential Geometry	06

		AMUETD7	Special Theory and Relativity	05
VI	CORE	AMUFTT1	Complex Analysis	05
		AMUFTT2	Numerical Analysis	05
	DSE (any two)	AMUFTD1	Discrete Mathematics	05
		AMUFTD2	Wavelets and Applications	05
		AMUFTD3	Number Theory	05
		AMUFTD4	Mathematical Finance	05
		AMUFTD5	C++Programming for Mathematics	05
		AMUFTD6	Cryptography	05
		AMUFTD7	Advanced Mechanics	05
		AMUFTD8	Dissertation on Any Topic of Mathematics	05

M.Sc. Mathematics (CBCS)

Semester	Course Name	Course code	Course	Credit Hours
I	Core	AMPATT1	Abstract Algebra	05
		AMPATT2	Topology	05
		AMPATT3	Discrete Mathematical Structures	05
		AMPATT4	Geometry of Manifolds	05
	Open Elective	AMPATO1	Applications of Fuzzy Sets & Fuzzy Logic	05
II	Core	AMPBTT1	Real Analysis	05
		AMPBTT2	Numerical Analysis	05
	DSE (Any Two)	AMPBTD1	Coding Theory	05
		AMPBTD2	Finsler Geometry	05
		AMPBTD3	Fluid Mechanics	05
		AMPBTD4	Mathematical Methods of Applied Mathematics	05
		AMPBTD5	Mathematical Statistics	05
		AMPBTD6	Riemannian Manifold and connections	05
		AMPBTD7	Fractional Calculus and Integral Transforms	05
	Research Methodology	AMPBTT3	Research Methodology	02

III	(Core)	AMPCTT1	Functional Analysis	05
		AMPCTT2	Theory of ordinary differential equations	05
	DSE (Any Two)	AMPCTD1	Algebraic Topology	05
		AMPCTD2	Complex Manifold	05
		AMPCTD3	Difference Equations	05
		AMPCTD4	Fuzzy Sets and Fuzzy Logic	05
		AMPCTD5	Information Theory and its Applications	05
		AMPCTD6	Integral Equation and Calculus of Variations	05
		AMPCTD7	Multipoint Iterative Methods	05
		AMPCTD8	Fundamentals of Elasticity	05
	Project	AMPCPF1	Project Phase-I	05
IV	Core	AMPDTT1	Complex Analysis	05
		AMPDTT2	Theory of partial differential equations	05
	DSE (Any Two)	AMPDTD1	Advanced Differential Equations	05
		AMPDTD2	Advanced Functional Analysis	05
		AMPDTD3	Applications of Fuzzy Logic	05
		AMPDTD4	Ring and Category of Modules	05
		AMPDTD5	Cryptography	05
		AMPDTD6	Financial Mathematics and its Applications	05
		AMPDTD7	Mathematical Ecology	05
		AMPDTD8	Operations Research	05
		AMPDTD9	Theory of Relativity	05
		AMPDTD10	Fundamentals of theoretical Seismology	05
	Project	AMPDPF1	Project Phase-II	05

23/01/2025

Dr. P. P. Murthy
(Head &Chairman)

Prof. A. S. Ranadive
(Member)

Prof. R. P. Dubey
(External-Member)

Dr. Sandeep Singh
(Member)

SUB CODE	L	T	P	DURATION/WEEK	IA	ESE	CREDITS
AMUCTT3	4	1	0	5 HOURS	30	70	5

Paper Code - AMUCTT3

PROBABILITY AND STATISTICS

Course Objectives: This course will enable the students to:

1) Understand distributions in the study of the joint behavior of two random variables.
2) Establish a formulation helping to predict one variable in terms of the other variable using the technique of correlation and linear regression.
3) Understand central limit theorem, which establish the remarkable fact that the empirical frequencies of so many natural populations, exhibit a bell shaped curve.
4) Translate real-world problems into probability models.
5) Learn the process of measuring the uncertainty of a random experiment.

Unit-I: Probability Functions and Moment Generating Function

Basic notions of probability, Conditional probability and independence, Baye's theorem; Random variables - Discrete and continuous, Cumulative distribution function, Probability mass/density functions; Transformations, Mathematical expectation, Moments, Moment generating function, Characteristic function.

Unit-II: Univariate Discrete and Continuous Distributions

Discrete distributions**:** Uniform, Bernoulli, Binomial, Negative binomial, Geometric and Poisson; Continuous distributions**:** Uniform, Gamma, Exponential, Chi-square, Beta and normal; Normal approximation to the binomial distribution.

Unit-III: Bivariate Distribution

Joint cumulative distribution function and its properties, Joint probability density function, Marginal distributions, Expectation of function of two random variables, Joint moment generating function, Conditional distributions and expectations.

Unit-IV: Correlation, Regression and Central Limit Theorem

The Correlation coefficient, Covariance, Calculation of covariance from joint moment generating function, Independent random variables, Linear regression for two variables, Themethod of least squares, Bivariate normal distribution, Chebyshev's theorem, Strong law oflarge numbers, Central limit theorem and weak law of large numbers.

Unit-V: Modeling Uncertainty

Uncertainty, Information and entropy, Uniform Priors, Polya's urn model and random graphs.

References:

1. Robert V. Hogg, Joseph W. McKean & Allen T. Craig (2013). *Introduction toMathematical Statistics* (7th edition), Pearson Education.
2. Irwin Miller & Marylees Miller (2014). *John E. Freund's Mathematical Statistics with Applications* (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India.
3. Jim Pitman (1993). *Probability*, Springer-Verlag.
4. Sheldon M. Ross (2014). *Introduction to Probability Models* (11th edition). Elsevier.

5. A. M. Yaglom and I. M. Yaglom (1983). *Probability and Information*. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi.

Course Outcomes: Upon successful completion of this course, students will be able to –

1) Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events.
2) Identify the type of statistical situation to which different probability distributions can be applied.
3) Use discrete and continuous probability distributions to solve statistical problems and make decisions.
4) Calculate and interpret the correlation between two variables and employee the principles of linear regression and correlation, predicting a particular value of Y for a given value of X and significance of the correlation coefficient.
5) Evaluate the degree of uncertainty of experiments.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	3	3	1		2	3	3	3	2		
CO2	3	2	2	3		2	1		1	1	2	3	2		
CO3	3	3	2	2	3	3	3		3	3	3	3	2		
CO4	3	3	3	3	3	3	3		3	3	3	3	2		
CO5	3	3	3	3	3	3	3		3	3	3	3	2		

Weightage: 1-Sightly, 2-Moderately, 2-Strongly

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SUB CODE	L	T	P	DURATION/WEEK	IA	ESE	CREDITS
AMUATA2	2	0	0	2 HOURS	30	70	2

Paper Code: AMUATA2

BASICS OF STATISTICS

Course Objective: This course will enable the students to -

1) Explain the basic ideas of measures of central tendency, dispersion and their applications.
2) Adapt the knowledge of various Probability distributions and their applications.
3) Apply statistical techniques for sampling of big data.
4) Explain a formulation helping to predict one variable in terms of the other that is, correlation and linear regression.
5) Translate real-world problems into probability models.

Unit-1: Review on Probability

Measures of Central Tendency, Measures of Dispersion, Probability, Conditional Probability, Random Variables, Expected Value, Moment generating function, Probability Distributions, Binomial Distribution, Poission Distribution, Normal Distribution.

Unit-2: Sampling Methods

Random Sampling and Methods of Samplings, Sampling distribution and standard error, Sampling distribution of the Sample Mean, Central limit theorem, Sampling distribution of the sample proportion, Sampling distribution of the difference between two sample means and Sampling distribution of the difference between two sample proportions.

Unit-3: Correlation and Regression

Correlation Karl Pearson's Coefficient of correlation, Rank correlation, linear regression, Lines of regression, Inferences concerning the regression coefficients.

References:

1. S. C. Gupta and V. Kapoor, Fundamentals of mathematical Stastics, Sultanchand and Son's, New Delhi.
2. Robert V. Hogg, Joseph W. McKean & Allen T. Craig(2013), Introduction to Mathematical Statistics(7th Edition), Person Education.
3. Irwin Miller &Marylees Miller (2014). *John E. Freund's Mathematical Statistics with Applications* (8thedition). Pearson. Dorling Kindersley Pvt. Ltd. India.JimPitman (1993). *Probability*,Springer-Verlag.
4. Sheldon M. Ross (2014). *Introduction to Probability Models* (11th edition).Elsevier.

5. A. M. Yaglom and I. M. Yaglom (1983). *Probability and Information*. D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi.

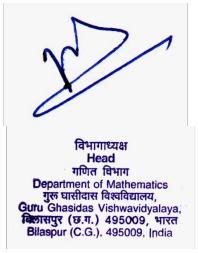
Course Objectives: Upon successful completion of this course, students will be able to -

1) Use the basic probability rules, including additive and multiplicative laws, using the terms, independent and mutually exclusive events.
2) Identify the type of statistical situation to which different probability distributions can be applied.
3) Use discrete and continuous probability distributions to solve statistical problems and make decisions.
4) Calculate and interpret the correlation between two variables and employee the principles of linear regression and correlation, predicting a particular value of Y for a given value of X and significance of the correlation coefficient.
5) Use sampling techniques and draw valid conclusion.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	3	3	1		2	3	3	3	2		
CO2	3	2	2	3		2	1		1	1	2	3	2		
CO3	3	3	2	2	3	3	3		3	3	3	3	2		
CO4	3	3	3	3	3	3	3		3	3	3	3	2		
CO5	3	3	3	3	3	3	3		3	3	3	3	2		

Weightage: 1-Sightly, 2-Moderately, 3-Strongly



SKILL ENHANCEMENT COURSE (SEC)

SUB CODE	L	T	P	DURATION/WEEK	IA	ESE	CREDITS
AMUATL1	2	0	0	2 HOURS	30	70	2

Paper Code: AMUATL1

INTRODUCTION TO CRYPTOGRAPHY

Course Objectives: - This course aims to -

1) Introduce students to the basic concepts and techniques used in cryptography, including encryption, decryption, key management, and digital signatures. This includes an overview of classic and modern cryptographic algorithms and their properties.
2) To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
3) Teach students how to analyze cryptographic protocols for their security and privacy properties. This includes topics such as formal verification, threat modeling, and security testing.
4) Teach students how to implement cryptographic algorithms using programming languages. This includes topics such as key generation, encryption, decryption, and digital signatures.
5) Provide students with an understanding of the challenges and issues faced by real-world cryptographic systems, such as side-channel attacks, timing attacks, and implementation flaws.

Basic Concept of Cryptography, Information security, Background on functions, Basic terminology and concepts, Symmetric-key encryption, Digital signatures, Authentication and identification, Public-key cryptography, Hash functions, Protocols and mechanisms, Key establishment, management and certification, Pseudorandom numbers and sequences, Classes of attacks and security models, Identification and Entity Authentication, Digital Signatures, Efficient Implementation, Patents and Standards. Basic concepts of elliptic curve and quantum cryptography.

Text Books:

1. Wenbo Mao, Modern Cryptography: Theory and Practice. Pearson Education, 2004
2. J Buchmann, Introduction to Cryptography, Springer (India) 2004
3. A. Menezes, P. van Oorschot and S. Vanstone, Handbook of Applied Cryptography, CRC Press

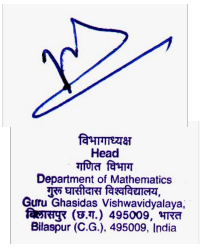
Course Outcomes: This course will enable the students to -

1) Develop the skills necessary to implement cryptographic algorithms, including the generation of keys, encryption, decryption, and digital signatures.
2) Gain knowledge of modern cryptographic algorithms, including symmetric-key and public-key cryptography, as well as their strengths and weaknesses.
3) Understand the importance of key management, including the distribution, storage, and revocation of cryptographic keys.
4) Develop critical thinking and problem-solving skills through practical exercises and assignments that require the application of cryptographic concepts and techniques.
5) Develop effective communication skills through written and oral presentations of technical material related to cryptography.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	1						1	2	2	1

Weightage: 1-Sightly, 2-Moderately, 3-Strongly



SUB CODE	L	T	P	DURATION/WEEK	IA	ESE	CREDITS
AMUATL2	2	0	0	2 HOURS	30	70	2

Paper Code: AMUATL2

SPECIAL FUNCTION

Course Objective: This course aims to -

1) Understand the properties of special functions like Gamma, Legendre functions with their integral representations.
2) Understand the concept of Bessel's function with its properties like recurrence relations, orthogonal properties, generating functions etc.
3) Understand how special function is useful in differential equations.
4) To determine properties of Legendre Polynomial this may be solved by application of special functions.
5) To analyze properties of special functions by their integral representations and symmetries.

Gamma function, Standard results for Gamma function, Beta function, Standard results for Beta function,

Bessel's function, Generating function, Orthogonality of Bessel's function, Recurrence relations for Bessel's function, Elementary Bessel's function, Legendre polynomial, Rodrigues's formula, Generating function Legendre polynomial, Orthogonality of Legendre polynomials.

Text Book:

1. B. V. Ramana (2007). *Higher Engineering Mathematics*, McGraw Hill Education (India) Pvt. Ltd.

Reference Book:

1. Z. X. Wang, D. R. Guo, Zhi Xu Wang (1989), Special Functions, World Scientific Publishing Company

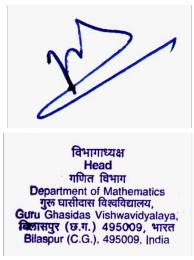
Course Outcomes: After completion of this course, student will be able to –

1) Understand the infinite product and properties of Beta and Gamma functions.
2) Analyze the properties generating functions.
3) Perform operations with Bessel and Legendre differential equations along with the corresponding recurrence formulas of different functions.
4) Demonstrate their understanding of how physical phenomena are modeled using special functions.
5) Explain the applications and the usefulness of special functions.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1				1		1	1	1	2	1	2
CO2	2	2	1	1		2		1		1	1	2	1	1	1
CO3															
CO4															
CO5															

Weightage: 1-Sightly; 2-Moderately; 3-Strongly



SUB CODE	L	T	P	DURATION/WEEK	IA	ESE	CREDITS
AMUBTL1	2	0	0	2 HOURS	30	70	2

Paper Code: AMUBTL1

GRAPH THEORY

Course Objectives: The main concern of Graph Theory is to -

1) Improve the proof writing skills.
2) Understand the basics of graph theory and their various properties.
3) Model problems using graphs and to solve these problems algorithmically.
4) Apply graph theory concepts to solve real world applications like routing, TSP/traffic control, etc.
5) Optimize the solutions to real problems like transport problems etc.,

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.

Books Recommended

1. B.A. Davey and H.A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

Course Outcomes: After successful completion of this paper the students will be able to:

1) Appreciate the definition and basics of graphs along with types and their examples.
2) Understand the definition of a tree and learn its applications to fundamental circuits.
3) Analyze the significance of graph theory in different engineering disciplines
4) Demonstrate algorithms used in interdisciplinary engineering domains.
5) Evaluate or synthesize any real world applications using graph theory.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	1						1	1	1	2	1

Weightage: 1-Sightly, 2-Moderately, 3-Strongly

SUB CODE	L	T	P	DURATION/WEEK	IA	ESE	CREDITS
AMUBTL2	2	0	0	2 HOURS	30	70	2

Paper Code: AMUBTL2

LINEAR PROGRAMMING

Course Objective: This course will enable the students to –

1) To understand basic terminology &basic concepts related to linear programming problems (LPP) of real life situations.
2) To understand the few initials method for the solutions of linear programming problems.
3) To get familiarize with the mathematical formulation of a real world problem.
4) To acquaint with the problem solving techniques theoretically as well as graphically.
5) To tackle several parameters into account while dealing with the problem and to make aware the students about the applications of various forms of Linear Programming.

Unit-I: Linear Programming Problem, Convexity and Basic Feasible Solutions

Linear Programming Problem, Convexity and Basic Feasible Solutions: Formulation, Canonical and standard forms, Graphical method; Convex and polyhedral sets, Hyperplanes, Extreme points; Basic solutions, Basic Feasible Solutions, Reduction of feasible solution to basic feasible solution, Correspondence between basic feasible solutions and extreme points.

Unit-II: Simplex Method

Optimality criterion, improving a basic feasible solution, Unboundedness, Unique and alternate optimal solutions; Simplex algorithm and its tableau format; Artificial variables, Big-*M* method.

Text Book:

1. Hamdy A. Taha (2017).Operations Research: An Introduction (10th edition).Pearson.

Reference Books:

2. Mokhtar S. Bazaraa, John J. Jarvis& Hanif D. Sherali (2010). Linear Programming and Network Flows (4th edition). John Wiley & Sons.
3. G. Hadley (2002). Linear Programming .Narosa Publishing House.

Course Outcome: Students will try to learn -

1) Basic understanding & terminology related to linear programming problems (LPP) of real life situations.
2) Some initials method for the solutions of linear programming problems, game problems.
3) Distinguish use of different methods to various kinds of LPP on the basis of type of

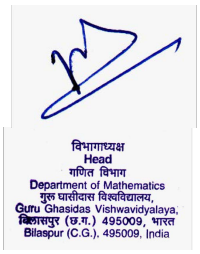
constraints and number of variable.

4) Judge Importance of solution obtained in terms of uniqueness, bound and optimality
5) Formulate mathematical model for management and technical problems using LPP concepts.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2						2	3	3	2	1
CO2	2	3	3	3	3						3	3	3	2	1
CO3															
CO4															
CO5															

Weightage: 1-Sightly; 2-Moderately; 3-Strongly



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DSE1.3 Analytical Geometry

Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola.

Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.

2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) Pvt. Ltd. 2002.

3. S.L. Loney, *The Elements of Coordinate Geometry*, McMillan and Company, London.

4. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

DSE2.1 Industrial Mathematics

Medical Imaging and Inverse Problems. The content is based on Mathematics of X-ray and CT scan based on the knowledge of calculus, elementary differential equations, complex numbers and matrices.

Introduction to Inverse problems: Why should we teach Inverse Problems? Illustration of Inverse problems through problems taught in Pre-Calculus, Calculus, Matrices and differential equations. Geological anomalies in Earth's interior from measurements at its surface (Inverse problems for Natural disaster) and Tomography.

X-ray: Introduction, X-ray behavior and Beers Law (The fundament question of image construction) Lines in the place.

Radon Transform: Definition and Examples, Linearity, Phantom (Shepp - Logan Phantom - Mathematical phantoms).

Back Projection: Definition, properties and examples.

CT Scan: Revision of properties of Fourier and inverse Fourier transforms and applications of their properties in image reconstruction. Algorithms of CT scan machine. Algebraic reconstruction techniques abbreviated as ART with application to CT scan.

Books Recommended

1. Timothy G. Feeman, *The Mathematics of Medical Imaging, A Beginners Guide*, Springer Under graduate Text in Mathematics and Technology, Springer, 2010.

2. C.W. Groetsch, *Inverse Problems*, Activities for Undergraduates, The Mathematical Association of America, 1999.

3. Andreas Kirsch, *An Introduction to the Mathematical Theory of Inverse Problems*, 2nd Ed., Springer, 2011.

DSE 2.2 Boolean Algebra and Automata Theory

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, lattices as ordered sets, lattices as algebraic structures, sublattices, products and homomorphisms.

Definition, examples and properties of modular and distributive lattices, Boolean algebras, Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method, Karnaugh diagrams, switching circuits and applications of switching circuits.

Introduction: Alphabets, strings, and languages. Finite Automata and Regular Languages: deterministic and non-deterministic finite automata, regular expressions, regular languages and their relationship with finite automata, pumping lemma and closure properties of regular languages.

Context Free Grammars and Pushdown Automata: Context free grammars (CFG), parse trees, ambiguities in grammars and languages, pushdown automaton (PDA) and the language accepted by PDA, deterministic PDA, Non- deterministic PDA, properties of context free languages; normal forms, pumping lemma, closure properties, decision properties.

Turing Machines: Turing machine as a model of computation, programming with a Turing machine, variants of Turing machine and their equivalence.

Undecidability: Recursively enumerable and recursive languages, undecidable problems about Turing machines: halting problem, Post Correspondence Problem, and undecidability problems About CFGs.

Books Recommended

1. B A. Davey and H. A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.

2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, (2nd Ed.), Pearson Education (Singapore) P.Ltd., Indian Reprint 2003.

3. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

4. J. E. Hopcroft, R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages,and Computation*, 2nd Ed., Addison-Wesley, 2001.

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5. H.R. Lewis, C.H. Papadimitriou, C. Papadimitriou, *Elements of the Theory of Computation*, 2nd Ed., Prentice-Hall, NJ, 1997.

6. J.A. Anderson, *Automata Theory with Modern Applications*, Cambridge University Press, 2006.

DSE2.3 Probability and Statistics

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to MathematicalStatistics*, Pearson Education, Asia, 2007.

2. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Applications*, 7th Ed., Pearson Education, Asia, 2006.

3. Sheldon Ross, *Introduction to Probability Models*, 9th Ed., Academic Press, Indian Reprint, 2007.

4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, *Introduction to the Theory ofStatistics*, 3rd Ed., Tata McGraw- Hill, Reprint 2007.

DSE3.1 Theory of Equations

General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule, Relation between the roots and the coefficients of equations.

Symmetric functions, Applications of symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

Symmetric functions of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

Separation of the roots of equations, Strums theorem, Applications of Strum's theorem, Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations.

Books Recommended

1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.

2. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

DSE3.2 Bio-Mathematics

Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC), Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario. Spatial Models: One species model with diffusion, Two species model with diffusion, Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population. Discrete Models: Overview of difference equations, steady state solution and linear stability analysis, Introduction to Discrete Models, Linear Models, Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting, Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.

Books Recommended

1. L.E. Keshet, *Mathematical Models in Biology*, SIAM, 1988.

2. J. D. Murray, *Mathematical Biology*, Springer, 1993.

3. Y.C. Fung, *Biomechanics*, Springer-Verlag, 1990.

4. F. Brauer, P.V.D. Driessche and J. Wu, *Mathematical Epidemiology*, Springer, 2008.

5. M. Kot, *Elements of Mathematical Ecology*, Cambridge University Press, 2001.

DSE3.3 Linear Programming

Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

Books Recommended

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and NetworkFlows,* 2nd Ed., John Wiley and Sons, India, 2004.

2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research,* 9th Ed., Tata McGraw Hill, Singapore, 2009.

3. Hamdy A. Taha, *Operations Research, An Introduction,* 8th Ed., Prentice-Hall India, 2006.

4. G. Hadley, *Linear Programming*, Narosa Publishing House, New Delhi, 2002.

DSE4.1 Mathematical Modeling

Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order.

Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence, Queuing Models: harbor system, morning rush hour, Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis

List of Practicals (using any software)

i. Plotting of Legendre polynomial for n = 1 to 5 in the interval [0,1]. Verifying graphically that all the roots of Pn (x) lie in the interval [0,1].

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
AMPATO1	4	1	-	5 hours	30	70	100	5

APPLICATIONS OF FUZZY SETS AND FUZZY LOGIC

Course Objective:

1. To learn to deal with uncertainty (of Fuzzy nature) and understand the scope of the subject.

2. To learn basic operations on Fuzzy sets and to understand the flexibility of various operations.

3. To understand the possibility theory and compare it with probability theory.

4. To understand the Fuzzy logic, implication rules, Fuzzification and Defuzzification methods.

5. To understand the application of Fuzzy logic in decision making under Fuzzy environment.

Syllabus Content:.

1. **From Classical (Crisp) sets to fuzzy sets: A grand paradigm shift and Operation on fuzzy sets**

Introduction, Crisp Sets: An overview, Fuzzy sets: basic types, Fuzzy sets: Basic concepts, Characteristics and signification of paradigm shifts.Types of operations, Fuzzy complements, Fuzzy intersections: t-Norms, Fuzzy unions: t-conorms, Combination of operations, Aggregation of operations

2. **Possibility Theory and Fuzzy Logic**

Fuzzy measures, Evidence Theory, Possibility theory, Fuzzy sets and possibility theory, Possibility theory vs. probability theory. Classical logic: An overview, multivalued logics, Fuzzy propositions, Fuzzy quantifiers, Linguistic hedges

3. **Approximate Reasoning**

Fuzzy expert system: an overview, Fuzzy implications, Selection of fuzzy implications, Multi conditional approximate reasoning, the role of fuzzy relation Equations, Interval-valued approximate reasoning.

4. **Fuzzy Systems**

General discussion, Fuzzy controllers: An overview, Fuzzy controllers: An Example, Fuzzy systems and neural networks, Fuzzy neural networks, Fuzzy automata, Fuzzy dynamic systems.

5. **Fuzzy decision making**

General discussion, Individual decision making, multi-person decision making, Multicriterial decision making, Multistage decision making, Fuzzy ranking methods, Fuzzy linear programming.

Text Book:

1. George J. Klir, Bo Yuan, Fuzzy sets and fuzzy logic Theory and Applications, PHI Publications 2002.

Reference Books:

1. Zimmermann, H. J. Fuzzy set theory and its applications. Springer Science & Business Media (2011).
2. Garg, H. Pythagorean, Fuzzy Sets- Theory and Applications. Springer, Singapore (2021).

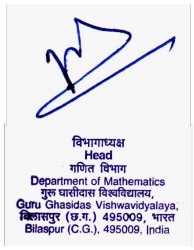
Course Outcomes: After completion of this course a student is supposed to know:

1. Learn to deal with real world uncertainties especially of the fuzzy nature and use it as mathematical tool available for cutting edge research in the area of his/her choice
2. Basics of fuzzy sets and the significance of application of fuzzy sets.
3. Use of fuzzy logic for decision making under real world scenario which is mostly fuzzy.
4. A student is supposed to understand the application as Fuzzy measures evidence theory, Possibility theory and probability theory.
5. Basics of fuzzy controller, idea of fuzzification and defuzzification.

Course Outcome and Their Mapping with Program Outcome & Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PS03	PS04
CO1	3	3	3	2		2	1	2	2	-	1	2	1	1	2	2
CO2	3	3	2	2		1	1	-	2	-	1	2	2	2	2	2
CO3	3	3	3	2		2	-	1	2	1	1	2	2	2	2	2
CO4	2	2	2	2		-	-	-	-	-	-	-	1	1	2	2
CO5	2	2	2	2		1	-	-	1	1	-	1	2	2	2	2

WEIGHTAGE: 1- Slightly, 2 – Moderately, 3 - Strongly



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Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
AMPBTD5	4	1	-	5 hours	30	70	100	5

MATHEMATICAL STATISTICS

Course objective: This course will enable the students to:

1. Understand different type of probability distributions.
2. Apply sampling technique to draw inferences about population.
3. Establish a formulation helping to predict one variable in terms of the other variables using the technique of correlation and regression.
4. Estimate the population parameters and evaluate the properties of estimators.
5. Translate real-world problems into probability models.

Basics of Random Variables: Introduction of Probability**,** Discrete and continuous random variables, probability mass function, probability density function, expectation, normal distribution.

Large Sample Theory: Types of sampling, parameter and statistic, tests of significance, procedure for testing of hypothesis, tests of significance for large samples, sampling of attributes, sampling of variables.

Exact sampling distributions-I: Derivation of the chi-square distribution, M.G.F. of chi-square distribution, some theorems on chi-square distribution, and applications of chi-square distribution.

Exact sampling distributions-II: Students 't' distribution, Fisher's 't', applications of t-distributions, distribution of sample correlation coefficient when population correlation coefficient is zero(ρ=0), F-distribution, applications of F-distribution, relation between t and F distributions, relation between F and chi-square distributions, Fisher's z-distribution, Fisher's z- transformation.

Theory of estimation: Estimators, characteristics of estimators, Cramer-Rao inequality, complete family of distributions, methods of estimation, confidence interval and confidence limits.

Correlation and regression: Linear regression (introduction) and curvilinear regression, regression curves, correlation ratio, multiple and partial correlation, plane of regression, properties of residuals, coefficient of multiple correlation, coefficient of partial correlation, multiple correlation in terms of total and partial correlation, expression for regression coefficient in terms of regression coefficients of lower order, expression for partial coefficient in terms of regression coefficients of lower order.

Text Book:

1. S. C. Gupta and V. K. Kapoor: Fundamentals of Mathematical Statistics, S. Chand and Sons, New Delhi (2004).

Reference Books

1. M. Ray and H. S. Sharma: Mathematical Statistics, Ram Prasad & Sons (1966).
2. D. N. Elhance, Fundamentals of Statistics, Kitab Mahal (1964).

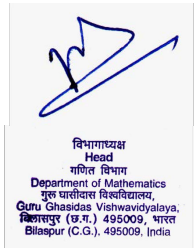
Course Outcomes: After completion of this paper students will be able to

1. Handle the real world problems regarding uncertainty of certain kind associated with random experiment.
2. Perform test of hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases and draw inferences about population.
3. Perform non-parametric test such as the Chi-square test for independence as well as goodness of fit.
4. Compute and interpret the results of bivariate and multivariate regression and correlation analysis, for forecasting. This paper is also useful for further study of statistics.
5. Apply the theory of estimation to draw valid conclusions.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	1	2	3	3	3	1	2	2	2
CO2	3	3	3	3	3	3	2	1	2	3	2	3	2	2	2	2
CO3	3	3	2	2	3	3	3	1	2	3	3	3	2	2	2	2
CO4	3	3	3	3	3	3	3	1	2	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	3	1	2	3	3	3	2	2	2	2

Weightage: 1-Sightly, 2-Moderately, 3-Strongly



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Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
AMPDTD3	4	1	-	5 hours	30	70	100	5

APPLICATIONS OF FUZZY LOGIC

Course Objectives: *Objective of the course is to make Students will able:*

1. To acquaint a student with modern tools of decision making.
2. Learn to tailor a fuzzy set as per requirement.
3. Learn generalization of rules of classical logic into the realm of fuzzy universe.
4. Learn decision making and finding solution of leaner programming problems.
5. Find out applications of fuzzy tools and the techniques in real world seniors.To learn the properties of direct sums and products of ring and modules.

1. Fuzzy Logic and Constructing Fuzzy Sets and Operation on Fuzzy Sets

Classical logic: An overview, multivalued logics, Fuzzy propositions, Fuzzy quantifiers, Linguistic hedges .General discussion, Methods of construction: An overview, Direct methods with one expert, Direct method with multiple experts, Indirect methods with one expert, Indirect methods with multiple experts, Construction from sample data

2. Approximate Reasoning

Fuzzy expert system: an overview, Fuzzy implications, Selection of fuzzy implications, Multi conditional approximate reasoning, the role of fuzzy relation Equations, Interval-valued approximate reasoning.

3. Fuzzy Systems

General discussion, Fuzzy controllers: An overview, Fuzzy controllers: An Example, Fuzzy systems and neural networks, Fuzzy neural networks, Fuzzy automata, Fuzzy dynamic systems.

4. Fuzzy decision making

General discussion, Individual decision making, multi-person decision making, Multicriterial decision making, Multistage decision making, Fuzzy ranking methods, Fuzzy linear programming.

5. Miscellaneous Applications

Introduction, Medicine, Economics, Fuzzy systems and genetic algorithm, Fuzzy regressions, Interpersonal communications, other applications

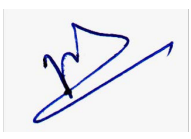
Text Book:

1. George J. Klir, Bo Yuan, Fuzzy sets and fuzzy logic Theory and Applications, PHI Publications 2002.

Reference Books:

2. Zimmermann, H. J., Fuzzy set theory—and its applications. Springer Science & Business Media (2011).
3. Garg, H., Pythagorean Fuzzy Sets- Theory and Applications. Springer, Singapore (2021).

Course Outcomes: Students will be able to understand after learning the course:

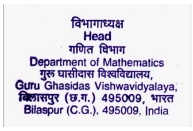


1. Use of fuzzy logic for decision making under real world scenario which is mostly fuzzy.
2. Basic idea of set theory and basics of fuzzy sets. The significance of application of fuzzy sets.
3. Basics of fuzzy controller, idea of fuzzification and defuzzification. Study of fuzzy controllers by mean of examples, Individual and Multiple decision making, Multicriteria and Multistage decision making.
4. Use of individual and multiple decision making, multicriteria and multi stage decision making methods under the fuzzy environment.
5. Over all use of fuzzy methods in the various disciplines in the general and particular areas of his\her interest.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	POS02	PSO3	PSO4
CO1	3	3	2	**2**		**1**		**1**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**2**
CO2	2	**2**	3	2		-		**1**	2	**1**	**1**	2	3	**3**	2	2
CO3	**2**	**2**	**3**	**2**		-		**1**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**2**
CO4	**2**	**2**	**2**	**2**		-		**1**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**2**
CO5	3	**2**	**2**	**2**		-		**1**	**2**	**2**	**1**	**3**	**3**	**2**	**3**	**2**

Weightage: 1-Sightly; 2-Moderately; 3-Strongly



Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
AMPDTD5	4	1	-	5 hours	30	70	100	5

CRYPTOGRAPHY

Course Objective: The Students undergoing this course are expected:

1. To learn fundamentals of cryptography and its application to network security.
2. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
3. Describe the process for implementing cryptographic systems and Identify processes for key administration and validation.
4. Describe the implementation of secure protocols, raise awareness of some of the legal and socio-ethical issues surrounding cryptography.
5. Explain the principles and underlying mathematical theory of today's cryptographic algorithms and provide an understanding of potential weaknesses and problems with ciphers and cryptographic protocols.

Unit I:

Introduction to cryptography: Basic Cryptography Concepts, Mono-alphabetic and Polyalphabetic cipher, The Shift Cipher, The Substitution Cipher, The Affine Cipher, The Vigenere Cipher, The Hill Cipher, The Permutation Cipher, Cryptanalysis, Some Cryptanalytic Attacks, Stream & Block ciphers, Mode of operations in block and stream cipher.

Unit II:

Shannon's Theory of Perfect Secrecy: Perfect Secrecy, Birthday Paradox, Vernam One Time Pad, Random Numbers, Pseudorandom Numbers.

DES & AES: The Data Encryption Standard (DES), Feistel Ciphers, Description of DES, Security analysis of DES, Differential & Linear Cryptanalysis of DES, Triple DES, The Advanced Encryption Standard (AES), Description of AES, analysis of AES.

Prime Number Generation: Trial Division, Fermat Test, Carmichael Numbers, Miller Rabin Test, Random Primes.

Unit III:

Public Key Cryptography: Principle of Public Key Cryptography, *RSA Cryptosystem*, Factoring problem, Cryptanalysis of RSA, RSA-OAEP, *Rabin Cryptosystem*, Security of Rabin Cryptosystem, Quadratic Residue Problem, Diffie-Hellman (DH) Key Exchange Protocol, Discrete Logarithm Problem (DLP), *ElGamal Cryptosystem*, ElGamal& DH, Algorithms for DLP, Elliptic Curve, Elliptic Curve Cryptosystem (ECC), Elliptic Curve Discrete Logarithm Problem (ECDLP).

Unit IV:

Cryptographic Hash Functions: Hash and Compression Functions, Security of Hash Functions, Iterated Hash Functions, SHA-1, Others Hash Functions, Message Authentication Codes.

Digital Signatures: Security Requirements for Signature Schemes, Signature and Hash Functions, RSA Signature, ElGamal Signature, Digital Signature Algorithm (DSA), ECDSA, Fail Stop Signature, Undeniable Signature, Blind Signature, Proxy Signature, Group Signature.

Unit V:

Identification and Authentication: Passwords, One Time Passwords, Challenge-Response Identification, Zero-Knowledge Proofs, The Schnorr Identification Scheme, The Okamoto Identification Scheme, Identity-based Identification Schemes.

Secret Sharing: The Principle, Shamir Secret Sharing Protocol.

Text Books:

1. Wenbo Mao, Modern Cryptography: Theory and Practice. Pearsion Education, 2004
2. J Buchmann, Introduction to Cryptography, Springer (India) 2004.
3. Bruce Schenier, Applied cryptography, John Wiley & Sons, 1996.B. Forouzan, Cryptography and Network security, Tata McGraw Hill, 2011.

Reference Books:

1. D. R. Stinson, Cryptography: Theory and Practice. CRC Press, 2000.
2. W. Starling, Cryptography and Network security, Pearson Education, 2004.

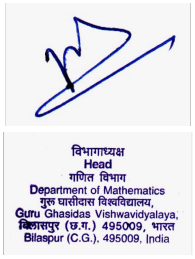
Course Outcomes: Upon the successful completion of the course, students will be able to:

1. Gain knowledge of modern cryptographic algorithms, including symmetric-key and public-key cryptography, as well as their strengths and weaknesses.
2. Understand the basic cryptographic concepts of confidentiality, integrity, authenticity, and non-repudiation, and how these concepts relate to cryptographic algorithms and protocols.
3. Learn how to analyze the security of cryptographic systems, including the identification of vulnerabilities and attacks, and the selection of appropriate cryptographic algorithms and protocols to mitigate risks.
4. Develop the skills necessary to implement cryptographic algorithms, including the generation of keys, encryption, decryption, and digital signatures.
5. Develop critical thinking and problem-solving skills through practical exercises and assignments that require the application of cryptographic concepts and techniques.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	2	1			2	1	1	2	2	2	2	3
CO2	3	2	2	2	2	2			2	2	1	2	2	2	2	3
CO3	3	2	2	3	2	2			2	2	3	2	2	3	2	2
CO4	3	2	2	3	2	3			2	3	2	2	3	2	2	3
CO5	3	2	3	3	3	2			2	3	3	3	3	3	2	3

Weightage: 1-Sightly, 2-Moderately, 3-Strongly



Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
AMPDTD6	4	1	-	5 hours	30	70	100	5

FINANCIAL MATHEMATICS AND ITS APPLICATIONS

Course Objective: The objective of this paper is to study:

1. Various types of financial instruments and their applications in various fields.
2. The Mathematical concepts of Black-Scholes formula and option Greeks for option pricing will be explained.
3. To have a proper understanding of mathematical applications in Economics, Finance, Commerce and Management.
4. Understand and assess the principles underlying the evaluation of the main securities that are available in the financial markets.
5. Explain how to evaluate, and assign a single value to a series of cash flows under different assumptions on the time value of money (interest).

Financial Derivatives: Meaning of financial derivatives, Types of financial derivatives – Forwards and futures, Advantages and disadvantages of forward and future contracts, Features of future contracts. Hedging using futures, Difference between forward and future contracts.

Technical analysis: Meaning of technical analysis, basic principal of technical analysis, bullish trend, bearish trend, support and resistance.

Mathematical Indicators: Moving averages, simple moving averages and exponential moving averages.

Options: Definition of option, types of options, call option and put option. Long call, long put, short call, short put, purpose of options, profit and pay of curve, open interest, change in open interest, volume, put call ratio based on open interest and volume, Volatility and implied volatility, Swaps.

Pricing contract via arbitrage: Explanation of option pricing and arbitrage with examples, the Arbitrage Theorem, proof of the Arbitrage Theorem, The multi-period binomial model.

The Black-Scholes Formula: Proof of Black-Scholes formula, properties of Black-Schole's option formula, the delta hedging arbitrage strategy.

Option Greeks: Delta, gamma, Vega, theta and rho, Mathematical and theoretical explanation of option Greeks.

Text Books:

1. John C Hall, Options, features and other derivatives, Prentice- Hall of India Private Limited.
2. Sheldon M Ross, An introduction to Mathematical Finance, Cambridge University Press.

Reference Books:

1 Sahil N. Nettci and Ali Hirsa, An introduction to Mathematics of financial derivatives, Academic Press Inc

2 Robert J Elliot and P. ekkehard Kopp, Mathematics of financial markets, Springer-verlag New Yark Inc
3 S. Kevin, Security analysis and portfolio management, PHI learning Private limited.
4 Redhead, Keith, 1998, Financial Derivatives- An Introduction to Futures, Forwards, Options and Swaps, PHI New Delhi.

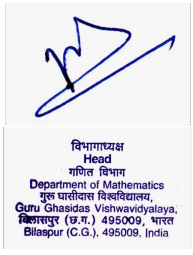
Course Outcomes: After successful completion of this paper the students will be able to:

1. Understand about the financial derivatives, technical analysis, Mathematical indicators and option Greeks used in option pricing of securities.
2. Employ methods related to these concepts in a variety of financial applications.
3. Apply logical thinking to problem solving in financial context.
4. Understand the mathematical concept of black schole's option prizing formula.
5. Use appropriate technology to aid problem solving.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	2			2	1	3	2	2	2	2	2
CO2	2	2	2	2	3	2			2	3	2	1	2	3	2	2
CO3	3	3	3	2	2	2			2	2	2	2	3	3	3	2
CO4	3	3	3	2	2	2			3	2	2	3	2	2	2	2
CO5	3	3	2	2	3	2			3	2	3	2	3	3	3	2

Weightage: 1-Sightly, 2-Moderately, 3-Strongly



Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
AMPDTD8	4	1	-	5 hours	30	70	100	5

OPERATIONS RESEARCH

Course Objectives: Student will be able to:

1. Formulate and solve some real life problems where integer optimal value is desirable.
2. Aware about CPM/PERT techniques.
3. Handle many optimization problems that involve large number of decision variables and/or large number of inequality constraints by the technique of dynamic programming.
4. Handle the queuing problem.
5. Solve unconstrained and constrained nonlinear programming problems.

Operation research: Origin and development of O.R., Nature and future of O.R., scientific method in O.R., Modelling in operation research, advantages and limitations of models, general solution methods for OR models, methodology of operation research, operation research and decision – making, applications of operational research.

Brief Review of LPP, simplex method, duality, Integer Programming: Introduction, Pure and mixed integer problems, Gomory's All I. P. P. method, construction of Gomory's constants, fractional cut method All I.P.P. , fraction cut method -mixed integer linear programming problem, Branch and bound method, applications of integer programming.

CPM/PERT: Basic definitions, activity, fullkerson's rule, event numbering, critical path, critical path method, forward and backward pass computation, network diagram, PERT.

Queuing theory: Queuing system, elements of a Queuing system, operating characteristics of a Queueing system, deterministic Queueing system, probability distributions in Queueing system, classification of Queueing models, definition of transient and steady states, Poisson Queueing systems, non-Poisson Queueing systems, cost models in Queueing, other Queueing models.

Dynamic programming problem: Introduction, the recursive equation approach, characteristics of dynamic programming, dynamic programming algorithm, solution of DPP, some applications, solution of LPP by dynamic programming.

Non-Linear Programming: Introduction, formulating a Non-linear programming problem (NLPP), general NLPP, constraint optimization with equality constraints, constraint optimization with inequality constraints.

Text Book:

1. Kanti Swarup, P. K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi.

Reference Books:

1. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
2. G. Hadley, Nonlinear and Dynamic Programming, Addison –Wesley, Reading Mass.
3. H. A. Taha, Operation Research- An Introduction, Macmillan Publishing Co. Inc., New York.
4. S. D. Sharma, Operation Research, S. Chand Publ. New Delhi.

Course Outcomes: Upon completion of this course, the student will be able to:

1. Formulate and solve some real life problems where integer optimal value is desirable.
2. Aware about CPM/PERT techniques.
3. Handle many optimization problems that involve large number of decision variables and/or large number of inequality constraints by the technique of dynamic programming.
4. Handle the queuing problem.
5. Solve unconstrained and constrained nonlinear programming problems.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	1	2	3	3	3	1	2	2	2
CO2	3	3	3	3	3	3	3	1	2	3	3	3	2	2	2	2
CO3	3	3	2	2	3	3	3	1	2	3	3	3	2	2	2	2
CO4	3	3	3	3	3	3	3	1	2	3	3	3	2	2	2	2
CO5	3	3	3	3	3	3	3	1	2	3	3	3	2	2	2	2

Weightage: 1-Sightly, 2-Moderately, 3-Strongly