PG & RESEARCH DEPARTMENT OF MATHEMATICS

PREAMBLE

UG : Course Profile, list of courses offered to the other departments & the syllabi of courses offered in the III, IV semester (With effect from 2021-2024 batch onwards)

PROGRAMME PROFILE B.Sc. (MATHEMATICS)

PROGRAMME SPECIFIC OUTCOMES

PSO No.	Upon completion of these Courses the Students would have
PSO-1	Become an individual academic excellence to face eligibility exams.
PSO-2	Acquired knowledge for higher studies.
PSO-3	Summarise the effective written communication of mathematical concepts.
PSO-4	Organize skills and knowledge that is translate information presented verbally into Mathematical form
PSO-5	Pursue a Higher Studies and become a software professional.

Semester	Part	Category	Course Code	Course Title	Previous course code	Contact Hours/ week	Credit Min/ Max
I	I	Languages /	UTAL107/	Basic Tamil-I/	UTAL105/	5	3/4
		AECC – II Tamil /	UTAL108/	Advanced Tamil-I/	UTAL106/		
		Hindi/	UHIL102/	Hindi-I /	UHIL101/		
		French	UFRL102	French-I	UFRL101		
	II	Communicative English/ AECC – I	UENL109/ UENL110	English for Communicative (Stream – I) / English for Communicative (Stream –II)		5	3/4
	III	Major Core (I)/ DSC (I)	UMAM104	Differential Calculus	-	6	4
	III	Major Core (II)/ DSC (II)	UMAM108	Algebra and Trigonometry		6	4
	III	Allied – I (GE)	UMAA117	Mathematical Statistics - I	UMAA115	6	4
	III	PE	UPEM101	Professional English		6	4
	IV	Value Education (VE)				2	1
					TOTAL	**36**	**23/25**
II	I	Languages / AECC –II Tamil/ Hindi/ French	UTAL207/ UTAL208/ UHIL202/ UFRL202	Basic Tamil II/ Advanced Tamil-II/ Hindi-II / French-II	UTAL205/ UTAL206/ UHIL201/ UFRL201	5	3/4
	II	Communicative English / AECC – I	UENL209/ UENL210	English for Communicative (Stream – I) / English for Communicative (Stream –II)		5	3/4
	III	Major Core III / DSC (III)	UMAM207	Vector Calculus		6	5

	III	Major Core IV / DSC(IV)	UMAM208	Analytical Geometry	UMAM105 / UMAM106	5	5
	III	Allied – II (GE)	UMAA207	Mathematical Statistics - II		6	4
	III	PE	UPEM201	Professional English II		6	4
	IV	Non Major Elective				3	2
	V	Extension Programme/ Physical Education				-	1/2
				TOTAL		**36**	**27/30**
III	I	Languages / AECC –II Tamil/ Hindi/ French	UTAL307/ UTAL308/ UHIL302/ UFRL302	Basic Tamil II/ Advanced Tamil-II/Hindi-II / French-II	UTAL305/ UTAL306/ UHIL301/ UFRL301	5	3/4
	II	Communicative English / AECC – I	UENL309/ UENL310	English for Communicative (Stream – I) / English for Communicative (Stream –II)		5	3/4
	III	Major Core V / DSC (V)_	UMAM308	Discrete Mathematics	UMAM206 / UMAM606	5	4
	III	Major Core VI/ DSC(VI)	UMAM309	Differential Equation	UMAM306 /UMAM302/ UMAM301	5	4
	III	Allied – III (GE)	UCSA304	Mathematical Programming using C	-	3	2
	III	Allied - III (GE) Practical	UCSR307	Mathematical Programming using C Practical	-	3	2
	IV	Online Course (NPTEL)				3	1/2
	IV	Value Education (VE)				2	1
					TOTAL	**31**	**20/23**
IV	I	Languages / AECC –II Tamil/ Hindi/ French	UTAL407/ UTAL408/ UHIL402/ UFRL402	Basic Tamil II/ Advanced Tamil-II/ Hindi-II / French-II	UTAL405/ UTAL406/ UHIL401/ UFRL401	5	3/4
	II	Communicative English / AECC – I	UENL409/ UENL410	English for Communicative (Stream –I) / English for Communicative (Stream –II)		5	3/4
	III	Major Core VII / DSC(VII)	UMAM407	Integral Transforms	UMAM405	4	4
	III	Major Core VIII / DSC (VIII)	UMAM408	Mechanics	UMAM406 /UMAM401	5	4
	III	Allied – IV (GE)	UPHA402	Electronics for Mathematics	-	3	2
	III	Allied – IV Practical	UPHR402	Electronics for Mathematics Practical	-	3	2
	IV	Soft Skill				2	1
	IV	Non Major Elective				3	2
	V	Extension Programme/ Physical Education				-	-/2
				TOTAL		**30**	**21/25**
V	III	Major Core IX / DSC (IX)	UMAM507	Modern Algebra	UMAM501	6	5
	III	Major Core X / DSC(X)	UMAM512	Real Analysis I	UMAM508	6	5
	III	Major Core XI / DSC (XI)	UMAM506	Number Theory	UMAM502	6	5

		Major Core XII/ DSC (XII)	UMAM510	Numerical Methods	-	6	5
		Major Core XIII/ DSC (XIII)	UMAP501/ UMAR511	Project/ R Programming	-	5	5
	IV	Value Education (VE)				2	1
					TOTAL	**30**	**25**
VI	III	Major Core XIV/ DSC (XIV)	UMAM614	Linear Algebra	UMAM604 / UMAM610	6	5
		Major Core XV/DSC (XV)	UMAM615	Real Analysis II	UMAM607 / UMAM611	6	6
		Major Core XVI/ DSC(XVI)	UMAM602	Complex Analysis	UMAM509	6	6
		Major Core XVI/ DSC(XVI)	UMAM613	Operations Research	UMAM603 / UMAM608	6	6
		Major Elective	UMAO606	Mathematics for Construction Craft	--		
			UMAO607	Mathematics in SpaceScience	--		
		Comprehensive Viva	UMAM601			-	1
	IV	Soft Skill				2	1
	V	Extension Programme/ PhysicalEducation				-	-/2
					TOTAL	**31**	**29/31**
					GRAND TOTAL	**194**	**145/159**

COURSES OFFERED TO OTHER DEPARTMENTS-UG ALLIED

Class &Major	Semester	Category	Course Code	Course Title	Previous course code	Contact Hours/ week	Credit Min/ Max
I B Com & I BCom (CA)	I	Allied	UMAA112	Business Mathematics	-	6	4
I B.SC PHY			UMAA114	Allied Mathematics I	UMAA106	6	5
I BCA			UMAA110	Mathematical Methods I	-	6	4
I B.Sc (CS)			UMAA113	Statistical Methods	-	6	4
I B.Sc (CS)	II		UMAA218	Mathematics for computer Science	-	6	4
II BCA			UMAA216	Mathematical Methods II		6	4
I B.SC PHY			UMAA222	Allied Mathematics II	UMAA212	6	5
II B.Sc Chem	III	Allied	UMAA312	Allied Mathematics for Chemistry I	UMAA304	6	5
II B.Sc BIO			UMAA307	Bio-Statistics	UMAA305	6	4
II BBA/ II B.COM/ II B.COM CA			UMAA301	Business Statistics	UMAA211/ UMAA403/ UMAA107	6	4
II B.Sc Chem	IV		UMAA408	Allied Mathematics for Chemistry II	UMAA406	6	5
II BBA			UMAA410	Quantitative techniques for Business	UMAA505	6	4

NON-MAJOR ELECTIVE

Semester	Part	Category	Course Code	Course Title	Previous course code	Contact Hours/ week	Credit
II	IV	Non Major Elective	UMAR201	Statistics using Excel	-	3	2
			UMAE204	Basic Mathematics for Science	-	3	2
			UMAE202	Mathematics for Business andDecision Making	-	3	2
			UIDE302/ UMAE302	Numerical Methods using C++	-	3	2
			UMAE306	Operations Research for Managers	UMAE402	3	2
			UMAA501/ UMAE305	Statistical Data Analysis throughSPSS	-	3	2
			UMAE308	Mathematics for Competitive Exams	UMAE502	3	2
IV	IV	Non Major Elective	UMAE404	Mathematics for Career Development	-	3	2

EXTRA CREDIT EARNING PROVISION

Semester	Part	Category	Coursecode	Course Title	Contact Hours/ week	Credit	
						Min	Max
II	III	Self Study paper	UMAI201	Summer Internship	-	-	1
IV	III	Self Study paper	UMAI401	Summer Internship	-	-	1
VI	III	Self Study paper	UMAS601 UMAS602 UMAS603 UMAS604	Fourier Transforms Simulation Number Theory Project	2	-	2

DISCRETE MATHEMATICS

UMAM308

Semester : III **Credit : 4**

Category : Major Core V / DSC (V) **Hours/Week : 5**

Class & Major : II B.Sc Mathematics **Total Hour : 65**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Understand the logic and its normal forms.
CO 2	Discuss about the Lattices and its properties.
CO 3	Apply Boolean functions and simplify expressions using the properties of Boolean algebra.
CO 4	Evaluate Permutations & Combinations.
CO 5	Construct Finite Automation and Non Finite Automation.

UNIT –I LOGIC **12 Hour**

Logic – Introduction - TF Statements – Connectives - Atomic and Compound Statements - Well formed (statement) formulae -Truth table of a formula – Tautology – tautological - Implications and Equivalence of Formulae - Normal Forms.

UNIT – II LATTICES **12 Hour**

Lattices- Some Properties of Lattices- New Lattices-Modular and Distributive Lattices.

UNIT – III BOOLEAN ALGEBRA **14 Hour**

Boolean algebra- Boolean Polynomials - Karnaugh Map - Switching Circuits.

UNIT – IV COMBINATORICS **13 Hour**

Introduction- Permutations & Combinations- Pascal`s Identity - Vandermonde`s Identity -Pigeonhole Principle – Principle of Inclusion and Exclusion.

UNIT – V AUTOMATA THEORY **14 Hour**

Automata - Introduction - Finite Automation – Definition - Representation of Finite Automation - Acceptability of a string by a Finite Automation - Languages accepted by a Finite automation - Non -Deterministic Finite automata - Acceptability of a String by Non - Deterministic Finite Automata - Equivalence of FA and NFA - Procedure for finding an FA equivalent to a given NFA.

Text Book

- Dr. Veerarajan.T. (2007). *Discrete Mathematics with Graph Theory and Combinatorics*.Tata McGraw Hill Education Pvt. Ltd.

Reference Books

- Sundaresan.V. Ganapathy Subramanian.K.S & Ganesan.K. (2000). *Discrete Mathematics*. A.R.Publications.
- Tremblay.J.P Manohar.R (2004). *Discrete Mathematical Structure with Applications toComputer Science.* Tata McGraw Hill Publishing Company Ltd.

Course Outcomes

CO No.	The student will be able to	Cognitive Level
CO 1	Recall the logic and its normal forms.	K1
CO 2	Describe the Lattices and its properties.	K2
CO 3	Apply Boolean algebra to circuits and gating networks.	K3
CO 4	Analyse Permutations & Combinations.	K4 & K5
CO 5	Construct Automata Formal Languages in Compiling and Complexity Theory	K6

DIFFERENTIAL EQUATIONS

UMAM309

Semester	**: III**	**Credit**	**: 4**
Category	**: Major Core V / DSC (V)**	**Hours/Week**	**: 5**
Class & Major	**: II B.Sc Mathematics**	**Total Hour**	**: 65**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Understand Linear, Non- Linear Ordinary Differential Equations.
CO 2	Explain the Concept of second order Differential Equation
CO 3	Demonstrate second order differential equations by repeated roots.
CO 4	Illustrate Linear and Non linear partial differential equations.
CO 5	Predict the Nonlinear Partial Differential Equation by standard forms.

UNIT – I FIRST ORDER DIFFERENTIAL EQUATIONS 13 Hour

Linear Equations with Variable Coefficients – Separable Equations – Differences between Linear and Non-linear Equations – Exact Equations and Integrating Factors.

UNIT – II SECOND ORDER DIFFERENTIAL EQUATIONS 13 Hour

Homogeneous Equations with Constant Co-efficient – Fundamental Solutions of Linear Homogeneous Equations – Linear Independence and the Wronskian - Complex roots of the Characteristic Equation.

UNIT – III SECOND ORDER DIFFERENTIAL EQUATIONS [CONTD] 13 Hour

Repeated roots; Reduction of Order – Non-Homogeneous Equations; Method of Undetermined Co-efficient – Variation of Parameters.

UNIT – IV LINEAR AND NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS **13 Hour**

Introduction – Elementary Arbitrary Functions – Complete Integral, Particular Integral, Singular Integral and General Integral – Special Methods of Solution applicable to certain Standard forms - Standard form I: only p and q present Standard form II – $z = px+qy+f(p,q)$.

UNIT – V NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS **13 Hour**

Standard form III: only p, q and z present – Standard form IV: Equations of the form $f_1(x,p) = f_2(y,p)$ – Charpit`s Method - Lagrange's Method – Working rule for Solving $Pp+Qq=R$ by Lagrange's Method.

Text Books

- Boyce-Diprima. (2008). *Elementary Differential Equations.* John Wiley & sons. Inc.New York.
- Vittal. P.R. (2010). *Differential Equations, Fourier & Laplace Transforms, Probability*. Margham Publications. Chennai.

Reference Books

- Grewal.B.S. (2002) *Higher Engineering Mathematics.* Khanna Publishers. New Delhi.
- Narayanan.S & Manickavachagom Pillay, T.K. (2006). *Differential Equations and itsApplications*. Vishwanathan.S Printers & Publishers Pvt Ltd., Chennai.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Define and Explain the concept of Linear Equations with Variable Coefficients	K1
CO 2	Solve the concept of second order differential equation with Complex roots of the Characteristic Equation.	K2
CO 3	Distinguish simple problems described by second order linear differential equations with constant coefficients.	K3
CO 4	Relate Linear and Non linear partial differential equations.	K4
CO 5	Formulate the Non linear Partial Differential Equation by standard forms.	K5

INTEGRAL TRANSFORMS

UMAM407

Semester	**: IV**	**Credit**	**:4**
Category	**: Major Core VII / DSC (VII)**	**Hours/Week**	**: 5**
Class & Major	**: II B.Sc Mathematics**	**Total Hour**	**: 65**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Understand the Fourier series.
CO 2	Describe the ideas of Laplace Transforms
CO 3	Use Fourier transforms for solving boundary value problems.
CO 4	Equip with the methods of finding Z transforms.
CO 5	Plan the methods of solving difference equations by using Z transforms.

UNIT- I FOURIER SERIES **13 Hour**

Fourier Series – Dirichlet's Conditions – Even and odd functions– Half-range Fourier series.

UNIT - II LAPLACE TRANSFORMS **13 Hour**

Laplace Transforms – Laplace Transforms Derivatives of Integrals – Periodic Functions Inverse Laplace Transforms - Solving Differential Equations using Laplace Transforms.

UNIT- III FOURIER TRANSFORMS **13 Hour**

Fourier Integral Theorem – Complex Fourier Transform – Inversion Theorem for Complex Fourier Transform – Properties of Fourier Transforms – Convolution Theorem – Parseval's Identity

UNIT-IV Z-TRANSFORMS **13 Hour**

Definition, Example and Properties of Z-transform – The Inverse Z-transform - Power Series Method.

UNIT-V SOLUTIONS OF DIFFERENCE EQUATIONS BY USING Z-TRANSFORM **13 Hour**

Partial Fraction Method, The Inverse Integral Method – Volterra Difference equation of Convolution type, Volterra Systems – Explicit Criteria for Stability of Volterra equation – Volterra Systems

Text Books

- Vittal. P.R. (2010). *Differential Equations, Fourier & Laplace Transforms*. Probability.Margham Publications. Chennai.
- Saber N. Elaydi. (2005). *An Introduction to Difference Equations.* Springer. Verlag NewYork.

Reference Book

- Kandasamy. P. & Thilagavathy. K. (2005). *Mathematics* Volume II, IV. S.Chand Publications.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Define the Fourier series.	K1
CO 2	Describe the Laplace transform and its properties.	K2
CO 3	Apply the Fourier Transforms and its real life application.	K3
CO 4	Solve problem using Z Transform.	K3
CO 5	Predict the methods of solving difference equations by using Z transforms.	K4

MECHANICS

UMAM408

Semester : IV **Credit :4**
Category : Major Core VIII / DSC (VIII) **Hours/Week :5**
Class & Major : II B.Sc Mathematics **Total Hour :65**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Recall the concept of forces.
CO 2	Describe the forces on a rigid body
CO 3	Apply the parallel forces, couple, resultant of couple.
CO 4	Analyse projectile and evaluation of its characteristics.
CO 5	Plan to find Law force and speed of a given orbit.

PART – I STATICS

UNIT-I FORCES **13 Hour**

Forces acting at a point – Parallelogram of forces – Triangle of forces – Lami's theorem.

UNIT-II FORCES ON A RIGID BODY **10 Hour**

Moment of a force – Moment of a Force about a Line – Scalar Moment, General Motion of a Rigid Body – Equations of Motions of a Rigid Body Kinetic energy of a Rigid Body.

UNIT-III FORCES ON A RIGID BODY (CONTINUATION) **12 Hour**

Parallel Forces – Point of application of Resultant of many Parallel Forces – Varignon's Theorem – Parallel Forces at the Vertices of a Triangle – Couples - Arm and Axis of a Couple – Resultant of several coplanar forces.

PART – II DYNAMICS

UNIT –IV PROJECTILES **15 Hour**

Forces on a Projectile, Nature of trajectory, Results Pertaining to the motion of the Projectile, Impulse force, Impact of Spheres, Impact of two smooth spheres, Impact of a smooth sphere on a plane.

UNIT - V CENTRAL ORBITS **15 Hour**

Central Orbit, Differential Equation of a Central Orbit, Finding Law Force and Speed of a given orbit the Law of Force.

Text Book

- Duraipandian. P. Laxmi Duraipandian and Muthamizh Jayapragasam. (2013).*Mechanics.* S.Chand & Co Pvt. Ltd. New Delhi.

Reference Book

- Joseph F. Shelley. (2005). Vector Mechanics for Engineers Volume - I: Dynamics. Tata MC Graw Hill edition. New Delhi.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Recall the concept of forces.	K1
CO 2	Recognize the forces on a rigid body	K2
CO 3	Apply the parallel forces, couple, resultant of couple.	K3
CO 4	Illustrate impulsive forces, & different types of impact.	K4
CO 5	Evaluate Simple Harmonic and Orbital Motions	K5

ALLIED PROGRAMMES OFFERED TO OTHER DEPARTMENT

ALLIED MATHEMATICS FOR CHEMISTRY- I

UMAA312

Semester : III **Credit : 4**
Category : Allied **Hours/Week : 6**
Class & Major : II B.Sc Chemistry **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Recall the Binomial, Exponential and Logarithmic series.
CO 2	Recognize the Skew-Hermitian matrices, Orthogonal and Unitary Matrices.
CO 3	Apply the techniques in Successive Differentiation.
CO 4	Expand the Trigonometric series and its applications.
CO 5	Evaluate hyperbolic function and their properties.

UNIT-I ALGEBRA **15 Hour**

Binomial Theorem for rational Index – Exponential and Logarithmic series – Summation and Sum of Co-efficients related to Binomial, Exponential and Logarithmic series. (Only Examples).

UNIT-II MATRICES **15 Hour**

Symmetric, Skew-Symmetric, Hermitian, Skew-Hermitian matrices, Orthogonal and Unitary Matrices. Characteristic roots and characteristic vectors-Cayley- Hamilton theorem (statement only) verification, to find the inverse using the above theorem.

UNIT-III DIFFERENTIAL CALCULUS **16 Hour**

Successive differentiation – Leibenitz theorem and its applications – Maxima and Minima – Roll's Theorem and Mean Value Theorem (Only examples).

UNIT-IV TRIGONOMETRIC SERIES **16 Hour**

Complex numbers-Applications of De-Moivre's theorem-Expansions of sinnθ, cosnθ, tannθ,-Expansions of $\sin^n\theta$, $\cos^n\theta$-Expansion of sinθ, cosθ, tanθ in powers of θ.

UNIT-V HYPERBOLIC FUNCTIONS **16 Hour**

Hyperbolic Functions-Inverse Hyperbolic Functions –relation between circular and hyperbolic functions, logarithm of complex numbers.

Text Books

- Narayanan and Manicavachagom Pillay,(1996). *Algebra Volume I.* Viswanathan.S Publishers & Printers Pvt. Ltd., Chennai.
- Kandasamy.P. and Thilagavathi. K. (1998*). Allied Mathematics Volume I&II*. S.Chand and Co.
- Narayanan and Manicavachagom Pillay, (1994.) *Calculus Volume I.* Viswanathan.S Publishers & Printers Pvt. Ltd., Chennai.
- Narayanan.S & Manicavachagom Pillay.T.K, (1994.)"*Trigonometry"*, Vishwanathan.S Printers & Publishers Pvt,Lltd., Chennai.

Reference Book

- Joseph F. Shelley. (2005). Vector Mechanics for Engineers Volume - I: Dynamics. Tata MC Graw Hill edition. New Delhi.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Define the binomial, Exponential and logarithmic series.	K1
CO 2	Describe the matrices such as Skew-Hermitian matrices, Orthogonal and Unitary Matrices.	K2
CO 3	Explain the techniques for Successive Differentiation.	K3
CO 4	Formulate the expansion of Trigonometric series.	K4
CO 5	Summarize hyperbolic function and their properties	K5

BIO-STATISTICS

UMAA307

Semester	**: III**	**Credit**	**: 4**
Category	**: Allied**	**Hours/week**	**: 6**
Class & Major : II B.Sc Bio-Chemistry		**Total Hour**	**: 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Define the basic concept & related to statistics.
CO 2	Discuss the measures of Central tendency.
CO 3	Apply the Measures of Dispersion in various fields.
CO 4	Distinguish Knowledge about correlation coefficients and regression.
CO 5	Interpret data via probability, conditional probability.

UNIT–I STATISTICAL METHODS **15 Hour**

Importance of Statistical Methods and their limitations – Collection, Classification and Tabulation of Statistical data – Diagrammatic and Graphical representation ofstatistical data.

UNIT – II MEASURES OF CENTRAL TENDENCY **15 Hour**

Measures of Central tendency – Mean, Median, Mode, Geometric Mean, Harmonicmean.

UNIT – III DISPERSION, SKEWNESS AND MOMENTS **16 Hour**

Measures of Dispersion – Range, Quartile deviation, Mean Deviation, Standard Deviation - Co-efficient of Variation – Lorenz curve - Skewness – Karl Pearson's, Bowley's and Kelly's co-efficient of Skewness – Skewness and Kurtosis based on Moments.

UNIT – IV CORRELATION AND REGRESSION ANALYSIS **16 Hour**

Correlation Analysis – Scatter Diagram – Karl Pearson's Co-efficient of Correlation – Spearman's Rank Correlation Coefficient – Co-efficient of Concurrent Deviation- Fitting of Straight line of the form $Y = ax + b$ by the method of least squares - Regression Analysis – Regression Lines – Regression Equations

UNIT – V PROBABILITY, RANDOM VARIABLES AND EXPECTATION **16 Hour**

Concept of Probability – Addition and Multiplication theorem of probability – Baye's Theorem - Concept of random variable - Distribution function – Definition of probability function for Discrete and Continuous Random Variable.

Text Book

- Pillai R.S.N. (2010). *Statistics: Theory and Practice*. S.Chand & Company Ltd. New Delhi.

Reference Books

- Gupta S.P. (2011). Statistical Methods. S.Chand & Company Ltd. New Delhi.
- Gupta.S.C. and Kapoor.V.K. (2008). Elements of Mathematical Statistics. S.Chand & Company Ltd. New Delhi.
- Snedecor G.W and Cochran W.G. (2006). Statistical Methods. Oxford Press and IBH.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Recall the Concepts of Statistics.	K1
CO 2	Illustrate the various measures of central tendency.	K2
CO 3	Apply the Measures of Dispersion in various fields.	K3
CO 4	Analyse the correlation coefficients and regression.	K3
CO 5	Evaluate the probability, conditional probability.	K4

BUSINESS STATISTICS

UMAA301

Semester : III **Credit : 4**
Category : Allied **Hours/week : 6**
Class & Major : II BBA/ II B.Com / II B.Com- CA **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Understand the various method of data collection and its diagrammatic representation
CO 2	Describe the measures of dispersion, skewness and moments.
CO 3	Apply the concepts of Correlation and Regression and its properties.
CO 4	Analyse the index number using Laspeyre's, Fishers, Paasche's methods and lot of living index numbers.
CO 5	Evaluate the Time series using measures of trend and measure of seasonal variation.

UNIT- I STAGES OF STATISTICAL SURVEY AND AVERAGES 15 Hour

Introduction- Nature, Scope and limitations of Statistics in Business – Collection of Data - Classification and Tabulation of data - Diagrammatic and Graphical Representation of data - Measures of Central tendency – Mean, median, mode, Geometric mean, Harmonic mean, quartiles, deciles, percentiles.

UNIT- II DISPERSION, SKEWNESS AND MOMENTS 15 Hour

Measures of Dispersion – Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Lorenz Curve - Skewness – Definition - Types of Skeweness – Absolute and Relative Measure of Skewness - Karl Pearson's Coefficient of Skewness, Bowley's Coefficient of Skewness & Kelly's coefficient of Skewness - Moments – Measures of Skewness and Kurtosis based on Moments

UNIT- III CORRELATION AND REGRESSION ANALYSIS 16 Hour

Correlation Analysis - Types of Correlation - Methods of Measuring Correlation - Karl Pearson's Coefficient of Correlation – Spearman's Rank Correlation coefficient – Regression Analysis - Regression Lines - Regression Equations.

UNIT- IV INDEX NUMBERS 16 Hour

Index numbers – Unweighted index numbers – Simple Aggregate Method – Simple Average of Price Relatives Method- Weighted Index Numbers – Weighted Aggregate Method –

Weighted Average of Price relatives method – Time reversal and factor reversal test - cost of living index number.

UNIT- V ANALYSIS OF TIME SERIES **16 Hour**

Time series – Components of Time series – Trend, seasonal variation, cyclical variation , irregular variation – methods of measuring trend – graphical method, semi average method, moving average method, method of least squares- methods of measuring seasonal variation- simple average method, ratio to moving average method.

Text Book

- Gupta S.P. (2006). *Statistical Methods.* S.Chand & Company Ltd. NewDelhi.

Reference Books

- Agarwal B.L. (2006). Basic Statistics. New Age International Publishers. (4th edn).
- Pillai R.S.N. (2010). Statistics: Theory and Practice. S.Chand & Company Ltd. New Delhi.
- Elhance D.N and Veena Elhance and Agarwal B.M. (2018). Fundamental of statistics. Kitab Mahal.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Understand the various methods of collection of data and representing through diagrams and graphs.	K1
CO 2	Recognise the concepts of measures of dispersion.	K2
CO 3	Explain the Correlation and Regression.	K3
CO 4	Evaluate index number using Laspeyre's, Fishers, Paasche's methods and lot of living index numbers.	K4
CO 5	Discuss and evaluates time series using measures of trend and measure of seasonal variation.	K5

ALLIED MATHEMATICS FOR CHEMISTRY –II
UMAA408

Semester : IV **Credit : 4**
Category : Allied **Hours/Week : 6**
Class & Major : II B.Sc Chemistry **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Understand the concept of Integrals.
CO 2	Recognize the Integration by parts and its applications.
CO 3	Apply the Full range Fourier series and half range Fourier series.
CO 4	Analyse the Laplace transform and inverse Laplace transform for solving ordinary differential equation with constant coefficient
CO 5	Design the Homogeneous Linear Differential Equations of the Second Order with Variable co-efficient.

UNIT-I INTEGRALS **15 Hour**

Integration by Substitution, Integration of Rational and Irrational Function of the form - Properties of Definite Integrals.

UNIT-II INTEGRALS (CNTD) **15 Hour**

Integration by parts-Double integrals-Applications of double integrals - areas.

UNIT-III FOURIER SERIES **16 Hour**

Fourier series for functions in $[0, 2\pi]$ and $[-\pi, \pi]$

UNIT-IV LAPLACE TRANSFORMS **16 Hour**

Laplace transform of functions - Inverse Laplace transforms - Application of Laplace Transforms in solving Differential Equations.

UNIT-V DIFFERENTIAL EQUATIONS **13 Hour**

Formation of Partial Differential Equation - Second Order Differential equations with Constant co-efficient - Homogeneous Linear Differential Equations of the Second Order with Variable co-efficient.

Text Books

- Manicakavachagam Pillai *T.K* (2001). *Ancillary Mathematics Integral Calculus*, S.Viswanathan Publishers & Printers.

Reference Books

- Narayanan and Manichavaschagam Pillay. (2000). Ancillary Mathematics, S.Viswanathan (Publishers & Printers) Pvt, Ltd.
- Grewal.B.S. (2002) Higher Engineering Mathematics. Khanna Publishers. New Delhi.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Recall the Integrals.	K1
CO 2	Recognize the applications of double integrals.	K2
CO 3	Apply the Fourier series, half range Fourier series.	K3
CO 4	Analyse the Laplace transform and inverse Laplace transform	K4
CO 5	Evaluate the partial differential equation and finding its solution.	K5

QUANTITATIVE TECHNIQUES FOR BUSINESS

UMAA410

Semester : IV **Credits : 4**
Category : Allied **Hours/Week : 6**
Class & Major: II BBA **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Knowledge about the linear programming problem in industry.
CO 2	Understand the techniques in Transportation Problem.
CO 3	Apply the assignment Problem.
CO 4	Analyze Game theory problems in business situations.
CO 5	Create the Network scheduling by PERT/CPM.

UNIT-I LINEAR PROGRAMMING PROBLEM **15 Hour**

Mathematical Formulation of the Problem- Graphical Solution Method- Some Exceptional Cases- General Linear Programming Problem- The Computational Procedure- Use of Artificial Variable Techniques- Big- M Method. Simple problems.

UNIT-II TRANSPORTATION PROBLEM **15 Hour**

General Transportation Problem-The Transportation Table-Loops in Transportation Tables-Solution of a Transportation Problem-Finding an Initial Basic Feasible Solution-Test for Optimality-Degeneracy in Transportation Problem-Transportation Algorithm (MODI Method). Simple problems.

UNIT-III ASSIGNMENT PROBLEM **16 Hour**

Mathematical Formulation of the problem- the Assignment method- Special Cases in Assignment Problem. Simple problems.

UNIT-IV GAME THEORY **16 Hour**

Two-person Zero-sum Games- Some Basic Terms- The Maximin - Minimax Principle- Games Without Saddle Points-Mixed Strategies- Graphic Solution of 2xn and mx2 Games- Dominance Property Simple problems.

UNIT-V NETWORK SCHEDULING BY PERT/CPM **16 Hour**

Network and Basic Components- Logical Sequencing- Rules of Network Construction- Critical Path Analysis- Probability Considerations in PERT- Distinction between PERT and CPM. Simple problems.

Text Book:

- Kanti Swaroop. Gupta P.K. and Manmohan. (2003). *Operation Research.* Sultan Chand & Sons. Delhi.

Reference Books:

- Kapoor .V.K. (2018). Introduction to Operation Research. Sultan Chand & Sons. Delhi.
- Sharma S.D. (2012). Operation Research. Kedar Nath Ram Nath & Co.
- Taha.A Hamdy.(2000). Operation Research - An Introduction. (6th edn) Prentice Hall of India Pvt Ltd. New Delhi.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Recall the Linear Programming Problem in industry.	K1
CO 2	Recognise the techniques in Transportation Problem.	K2
CO 3	Formulate the assignment Problem.	K3
CO 4	Analyze Game theory problems in business situations.	K3
CO 5	Construct the Network scheduling by PERT/CPM.	K4

MATHEMATICS FOR CAREER DEVELOPMENT

UMAE404

Semester : IV **Credit : 2**
Category : Non Major Elective **Hours/Week : 3**
Class & Major : II UG **Total Hour : 39**

COURSE OBJECTIVES

CO No.	To enable the students
CO 1	Knowledge about the Number System, Simplification using Formula and Rule.
CO 2	Understand the averages and Percentage.
CO 3	Apply the Profit and loss in real life.
CO 4	Analyze the Time and Work Concept and its Application to Cisterns and Pipes.
CO 5	Evaluate the problems of time and distance & boats and streams.

UNIT I NUMBER SYSTEM **7 Hour**

Number System – Simplification using formulae and rules – L.C.M and H.C.F of 2 or more numbers

UNIT II AVERAGE AND PERCENTAGE **8 Hour**

Averages - Percentage

UNIT III PROFITAND RATIO **8 Hour**

Profit and Loss -Ratio and Proportion

UNIT IV TIME AND WORK **8 Hour**

Time and Work – Cisterns and Pipes

UNIT V TIME AND DISTANCE **8 Hour**

Time and Distance –Boats and Streams

Text Book

- Dr. Aggarwal R.S. (2017). *Quantitative Aptitude for Competitive Examinations.* Sultan Chand & Sons. Delhi.

Reference Books

- ParveenKumar. (2020). Arithmetic for Competitive Exam. S D Publications.
- Dinesh Khattar. (2019). Quantitative Aptitude for Competitive Examinations. Pearson. India.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Demonstrate Number System, Simplification using Formula and Rule.	K1
CO 2	Compute Averages, Percentage and Data Representation through Diagram.	K2
CO 3	Use the Profit and loss in real life situations..	K3
CO 4	Explain the concept of Time and Work	K4
CO 5	Construct the Time and Distance concept and Apply to Cisterns and Pipes.	K5

III & IV EVALUATION COMPONENTS OF CIA

Semester	Category	Course code	Course Title	Component III	Component IV
III	Core V	UMAM308	Discrete Mathematics	Term Paper	Problem Solving
	Core VI	UMAM309	Differential Equation	Term Paper	Problem Solving
IV	Core VII	UMAM407	Integral Transforms	Assignment	Problem Solving
	Core VIII	UMAM408	Mechanics	Model Building	Seminar

III &IV EVALUATION COMPONENTS OF CIA-Allied

Semester	Category	Course Code	Course Title	Component III	Component IV
III	Allied	UMAA307	Bio-Statistics	Assignment	Problem Solving
		UMAA312	Allied Mathematics for Chemistry -I	Assignment	Problem Solving
		UMAA301/ UMAA211/ UMAA403/ UMAA107	Business Statistics	Assignment	Problem Solving
IV		UMAA408	Allied Mathematics for Chemistry – II	Assignment	Problem Solving
		UMAA410/ UMAA505	Quantitative techniques for Business	Assignment	Problem Solving

III & IV EVALUATION COMPONENTS OF CIA-NME

Semester	Category	Course code	Course Title	Component III	Component IV
IV	NME	UMAE404	Mathematics for Career Development	Assignment	Problem Solving

PROGRAMME PROFILE M.Sc. (MATHEMATICS)

PREAMBLE

PG : Programme Profile, list of Courses offered to the other Departments and the Syllabi ofCourses offered in the III and IV Semesters (With Effect From 2021-2023 Batch Onwards)

PSO 1 : Understanding of Advanced Concepts, Principles and Techniques from Pure & Applied Topics in Mathematics and Application of Problem -Solving Skills.

PSO 2 : Development of Abstract Mathematical Thinking and Mathematical Intuition.

PSO 3 : Assimilation and Communication of detailed Technical Arguments.

PSO4 : Proficiently to Construct and Formulate Logical Arguments, Conjectures and Construction of Rigorous Proof by Abstracting Principles.

PSO 5 : Ability to carry out extended Investigation of Mathematical Work as various Projects Independently.

Semester	Category	Course Code	Course Title	Previous course code	Contact Hrs/ Week	Credit Min/ Max
I	Major Core I / DSC I	PMAM108	Abstract Algebra	PMAM107	6	4
	Major Core II/ DSC II	PMAM102	Real Analysis	-	6	4
	Major Core III / DSC III	PMAM103	Ordinary Differential Equations	-	6	4
	Major Core IV / DSC IV	PMAM105	Calculus Of Variations And Integral Equations	-	6	4
	Major Core V / DSC V	PMAM106/ PMAM407	Fuzzy Analysis	-	6	4
			TOTAL		**30**	**20**
II	Major Core VI/ DSC VI	PMAM210	Linear Algebra	PMAM209	5	4
	Major Core VII / DSC VII	PMAM202	Measure and Integration	-	5	4
	Major Core VIII / DSC VIII	PMAM206	Partial Differential Equations	-	5	4
	Major Core IX / DSC IX	PMAM207	Classical Mechanics		5	4
	Major Core X / DSC X	PMAM208	Operations Research		5	4
	Non Major Elective				5	4
	Service Learning	PMAX201/ PMAX202	Mathematics for High School Students \Elementary Mathematics for Higher Secondary Students		-	1
	Online Course	PONL201	NPTEL		-	1 /2
	Internship	PMAI201	Internship / Field Work / Field Project (30 Hours)	-	-	- / 1
			TOTAL		**30**	**25 / 28**
	Major Core XI / DSC XI	PMAM305	Complex Analysis	-	6	4
	Major Core XII / DSC XII	PMAM310	Fluid Dynamics	-	6	4
	Major Core XIII / DSC XIII	PMAM314	Topology	PMAM311	6	4
	Major Core XIV / DSC XIV	PRMC301	Research Methodology	-	5	4

III	Major Core XV/DSC XV	PMAI312	Number Theory andCryptography	-	5	4
	Major Core XVI/ DSC XVI	PMAP401	Project	-	2	-
			TOTAL		**30**	**20**
IV	Major Core XVII / DSCXVII	PMAM405	Functional Analysis	-	6	5
	Major Core XVIII / DSCXVIII	PMAM410	Probability theory	-	6	5
	Major Core XIX / DSCXIX	PMAM409	Numerical Analysis	-	7	5
	Major Core XX / DSC XX	PMAM411	Differential Geometry	PMAM403	6	5
	Major Core XXI / DSCXXI	PMAP401	Project	-	4	5
	Internship	P MAI401	Internship / Field Work / FieldProject (30 Hours)	-	-	- / 1
	Library				1	-
			TOTAL		**30**	**25**
			GRAND TOTAL		**120**	**90/ 93**

PROGRAMMES OFFERED TO OTHER DEPARTMENTS – PG

Semester	Category	Course Code	Course Title	Contact Hrs/ Week	Credit Min/ Max
II	Non Major Elective	PMAE201	LaTeX and MaTLab	3	4
	Practical		LaTeX and MaTLab	2	
	Non Major Elective	PMAE202	Operations Research	5	4
		PMAE203	Discrete mathematics	5	4
		PMAE204	NET/SET/ Competitive Exam	5	5

EXTRA CREDIT EARNING PROVISION

Semester	Category	Course code	Course Title	Hrs/ week	Credit Min /Max
III	Self-Study Paper	PMAS301/	Difference Equation	2	-/1
		PMAS302	Combinatorial Analysis	2	-/1

COMPLEX ANALYSIS

PMAM305

Semester : II **Credit : 4**
Category : Core XI **Hours/Week : 6**
Class & Major: II M. Sc. Mathematics **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Understand the basics of complex line integral and Cauchy theorem.
CO-2	Recognize the Definite integrals and Schwarz theorem.
CO-3	Apply the Arzela's theorem.
CO-4	Analyse the Riemann Mapping Theorem.
CO-5	Create the fascinating world of elliptic functions which is markedly different from analyzing real variable.

UNIT-I THE GENERAL FORM OF CAUCHY THEOREM 15 Hour

Chains and cycles – Simple continuity – Homology – The General statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Local exact differential – Multiply connected regions – Residue Theorem – The Argument Principle.

UNIT-II EVALUATION OF DEFINITE INTEGRALS AND HARMONIC FUNCTIONS AND POWER SERIES EXPANSIONS 16 Hour

Evaluation of Definite Integrals – Schwarz Theorem – Weierstras-p s Theorem – Taylor's Series –Laurent Series.

UNIT-III PARTIAL FRACTION AND ENTIRE FUNCTIONS 15 Hour

Gamma Function - Equicontinuity -Normality and compactness - Arzela's theorem-Families of analytic function-The Classical definition.

UNIT-IV RIEMANN MAPPING THEOREM 16 Hour

Statement and Proof - Behavior at an angle - Schwarz - Christoffel formula – Mapping on a rectangle - Functions with mean value property – Harnacks principle.

UNIT-V ELLIPTIC FUNCTIONS 16 Hour

Simply Periodic Functions - Doubly Periodic Functions.

Text Book

- Lars V. Ahlfors. (1979). *Complex Analysis.* [3rd Edn]. McGraw Hill. New York.

Reference Books

- Conway J.B. (1978). *Functions of one complex variables*. Springer – Verlag, International student Edition, Narosa Publishing Co.
- Hille E. (1959). *Analytic Function Theory* [2 vols]. Gonm & Co.
- Heins M. (1968). *Complex Function Theory*. New York, Acamedic Press.
- Presfly H.A. (1990). *Introduction to Complex Analysis*. Clarendon Press, Oxford.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Recognize good foundation on Cauchy theorem at advanced level.	K1
CO 2	Demonstrate the Definite Integrals of entire functions	K2
CO 3	Test in-depth understanding of Entire functions.	K3
CO 4	Analyse the Functions with mean value property.	K4
CO 5	Develop Insight into periodic functions.	K5

FLUID DYNAMICS

PMAM310

Semester : III **Credit : 4**
Category : Core XII **Hours/Week : 6**
Class &Major : II M.Sc Mathematics **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Understand the physical properties of a fluid and the consequence of properties on fluid flow.
CO-2	Identify the equations of motions of a fluid element.
CO-3	State the Three Dimensional Flows.
CO-4	Analyse the two dimensional Flows.
CO-5	Create models of viscid, steady fluid flow over simple profiles and shapes.

UNIT – I KINEMATICS OF FLUIDS IN MOTION **16 Hour**

Real Fluids and ideal fluids – Velocity of a fluid at a point – Streamlines and Pathlines – Steady and Unsteady Flows – The Velocity Potential, the Vorticity vector – Local and particle rates of change – The Equations of Continuity – Conditions at a rigid boundary – General analysis of Fluid Motion.

UNIT- II EQUATIONS OF MOTION OF A FLUID **14 Hour**

Pressure at a point in a fluid at rest – pressure at appoint in a moving fluid – conditions at a boundary of two inviscid immiscible fluids - Euler's equations of motion – Bernoulli's equation

UNIT- III THREE DIMENSIONAL FLOWS **14 Hour**

Introduction- Sources sinks and doublets – Images in a rigid infinite plane – images in solid spheres – Axis - symmetric flows – strokes stream function – symmetric irrotational motions.

UNIT- IV TWO DIMENSIONAL FLOWS **18 Hour**

Meaning of two dimensional flow – Use of cylindrical polar coordinates – The stream function – The complex potential for two – Dimensional, irrotational, incompressible flow – Complex velocity potentials for standards two dimensional flows- uniform stream – Line sources and line sinks – Line doublets – Line votices, Mline Thomson circle theorem –The theorem of Blasius.

UNIT-V VISCOUS FLOW **16 Hour**

Stress components in real fluid – relations between Cartesian components of stress – translational motion of fluid element – the rate of strain quadric and principal stresses – some further properties of rate of strain quadric – stress analysis in fluid motion – the coefficient of viscosity and laminar flow – the navier – strokes equations of motion of a viscous fluid.

Text Book

- Chorlton .F. (2004). *Text book of Fluid Dynamics.* CBS Publishers & Distributors. New Delhi.

Reference Books

- Batcherlor.C.K. (2000). *An Introduction to fluid Mechanics.* Cambridge University Press.
- Miline and Thomson L.M.(2013). *Theoretical Hydrodynamic.* 1962.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Understand the fluids based on the physical properties of a fluid.	K1
CO 2	Descibe the kinematical properties of a fluid element.	K2
CO 3	Test in-depth understanding of three dimensional flows.	K3
CO 4	Analyse the two dimensional flows.	K4
CO 5	Construct models of viscous flow.	K5

TOPOLOGY

PMAM314

Semester : III **Credit : 4**
Category : Core XIII **Hours/Week : 6**
Class &Major: II M.Sc Mathematics **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Recall Metric space, Open set, Closed set theorems, completeness and Continuous Function
CO-2	Recognize the concept of continuous mappings between topological spaces.
CO-3	Explain the Urysohn metrization theorem and Tychonoff theorem
CO-4	Find the basics of connectedness and compactness of a topological space.
CO-5	Construct the Weierstrass Approximation Theorem.

UNIT-I METRIC SPACES **16 Hour**

Partially Ordered Set and Lattices – Metric Spaces – Definitions and Examples –Open Sets– Closed sets – Convergence, Completeness and Baire's theorem – Continuous Mappings – Spaces of Continuous Function – Euclidean and Unitary Spaces.

UNIT-II TOPOLOGICAL SPACES & COMPACTNESS **16 Hour**

Definitions and Examples – Elementary Concepts – Open base and Open Sub base – Weak Topologies – The Function Algebras – Compactness – Compact Spaces – Product Spaces – Tychonoff's Theorem and Locally Compact Spaces – Compactness for Metric Spaces – Ascolis Theorem.

UNIT-III SEPARATION **16 Hour**

T_1 spaces Hausdroff's spaces – Completely Regular Spaces and Normal Spaces – Urysohn's Lemma and Tietze Extension Theorem – The Urysohn's Embedding Theorem – The Stone-Cech Compactification.

UNIT-IV CONNECTEDNESS **14 Hour**

Connected Spaces – The Components of a Space – Totally Disconnected Spaces – Locally Connected Spaces.

UNIT-V APPROXIMATION **16 Hour**

The Weierstrass Approximation Theorem – The Stone -Weierstrass Theorem – Locally Compact Hausdorff Spaces – The Extended Stone - Weierstrass Theorem.

Text Book

- George F. Simmons. (1999). *Introduction to Topology and Modern Analysis*. McGraw Hill, New Delhi.

Reference Books

- Dugunji.J., (1975). *Topology.* Prentice Hall of India, New Delhi.
- Munkers R James. (2002). *A first course in Topology*. Pearson Education. Pvt.Ltd. New Delhi.

COURSE OUTCOMES

CO No.	**The student will be able to**	**Cognitive Level**
CO 1	Recognize terms, definitions and theorems related to metric spaces.	K1
CO 2	Demonstrate concepts such as open and closed sets, interior, closure and boundary.	K2
CO 3	Examine Urysohn's Lemma and Tietze Extension Theorem.	K3
CO 4	Describe the theoretical concepts of the Components of a Space.	K4
CO 5	Develop new topological spaces by using Weierstrass Theorem.	K4

RESEARCH METHODOLOGY
PRMC301

Semester	**: III**	**Credit**	**: 4**
Category	**: Core XIV**	**Hours/Week**	**: 5**
Class &Major	**: II M. Sc Mathematics**	**Total Hours**	**: 65**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Understand the Basic Concepts of Research using various Methodologies
CO-2	Identify Appropriate Research Topics
CO-3	Select appropriate Research Problem and Parameters
CO-4	Prepare A Project Proposal (To Undertake A Project)
CO-5	Organize and Conduct Research (Advanced Project) in a more appropriate Manner and write a Research Report.

UNIT I INTRODUCTION TO RESEARCH METHODOLOGY 7 Hour

Meaning of research – Objective of Research – Motivation in Research – Types of Research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical – Research Approaches – Significance of Research – Research Methods versus Methodology – Research and Scientific Methods – Importance of Knowing How Research is Done – Research Process – Criteria for Good Research.

UNIT II RESEARCH PROBLEM AND RESEARCH DESIGN 15 Hour

Research Problem – Selecting Research Problem – Necessity of Defining A Problem – Techniques of Defining Problem – Formulation of Research Problem, Objectives of Research Problem. Meaning of Research Design – Need for Research Design – Important Concept Related to Research Design – Different Research Designs – Basic Principles of Experimental Design; Important Experimental Design.

UNIT III SAMPLING DESIGN, DATA COLLECTION AND ANALYSIS 18 Hour

Census And Sample Surveys – Characteristics of Good Sample Design – Different Types of Sample Designs – Techniques of Selecting a Random Sample-Accepts of Method Validation – Observation and Collection of Data – Methods of Data Collection – Sampling Methods – Data Processing and Analysis Strategies and Tools – Data Analysis with Statically Package (Sigma STAT,SPSS For Student T-Test, ANOVA, Etc.), Hypothesis Testing.

UNIT IV INTERPRETAION, REPORT WRITING, RESEARCH ETHICS AND IPR 15 Hour

Interpretation and Report Writing – Meaning of Interpretation; Techniques of Interpretation; Precautions in Interpretation; Significance of Report Writing, Layout of Research Report, Types of Reports; Presentation of Research Work-Oral, Poster and Writing Research Paper; Precautions for Writing Research Report, Conclusion.

Ethics-Ethical Issues, Related to Research, IPR-Intellectual Property Rights in Research and Development-Patents and Patent Laws: Objectives of the Patent System - Basic, Principles and General Requirements of Patent Law.

UNIT V INTRODUCTION AND TOOLS FOR TO LATEX **10 Hour**

Basic LaTex – Sample document and Key Concepts – Type style – Lists – Tables – vertical and horizontal spacing- Some common structures – mathematical symbols – arrays – space – change style – List - Defining commands and environment – Figures and tables – Tabular environment - sectioning – declaration – change the type style – accents – symbols.

Text books

- Kothari, C. R. (1980). Research Methodology: Research and techniques, New Delhi: New Age International Publishers
- Carlos, C.M.,2000.Intellectual property rights. the WTO and developing countries: the TRIPS agreement and policy options. ZedBooks, New York.
- Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.
- Darren George and Paul Mallery – SPSS for Windows, Pearson Education
- David F Griffiths and Desmond J. Higham," *Learning LaTex",* SIAM (Society for Industrial and Applied Mathematics) Publishers, Phidel Phia, 1996.

References

- Kothari, C. R. (1990). Research Methodology: Research and techniques, New Delhi: New Age International Publishers.
- Singh, Y. K. (2006). Fundamental of Research Methodology and Statistics. New Delhi. New International (P) Limited, Publishers.
- Wallinman, N. (2006). Your Research Project: A step-by-step guide for the first-time researcher. London: Sage Publications
- Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety andBiotechnology Management, Jasen Publications, India.
- Martin J. Erickson and Donald Bindner, A Student's Guide to the Study, Practice, and Tools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011.

e-Books

- http:// www.ptt.ed/-super7/430114401/4391.ptt/.
- https://www.heacademy.ac.uk/system/files/msor.3.Is.pdf
- 164.100.133.129.81/econtent/uploads/research-methods.pdf

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Recall the concepts of research Methodology.	K1
CO 2	Recognise the Research problem and research design.	K2
CO 3	Apply some data in research questions to do better research.	K3
CO 4	Appraise a research proposal or industry project plan.	K4
CO 5	Design the documentation and ethics proposals.	K5

NUMBER THEORY AND CRYPTOGRAPHY
PMAI312

Semester : III **Credit : 4**
Category : Core XV **Hours/Week : 5**
Class &Major : II M.Sc Mathematics **Total Hours :65**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Recall the Divisibility and congruences.
CO-2	Recognize the congruences and primitive roots.
CO-3	Relate security concepts of Cryptography.
CO-4	Analyse Symmetric Key Ciphers.
CO-5	Construct code in cryptographic hash functions.

UNIT - I DIVISIBILITY **13 Hour**

Introduction – Divisibility – Primes – The Binomial Theorem – Congruences – Euler's totient - Fermat's, Euler's and Wilson's Theorems – Solutions of congruences – The Chinese Remainder theorem.

UNIT - II CONGRUENCES **13 Hour**

Techniques of numerical calculations – Prime power Moduli – Primitive roots and Power Residues – Congruences of degree two - Number theory from an Algebraic Viewpoint

UNIT - III SECURITY CONCEPTS **13 Hour**

Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms. Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT - IV SYMMETRIC KEY CIPHERS **13 Hour**

Block Cipher principles, DES, AES, Blowfish, Block cipher operation, Stream ciphers, Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange.

UNIT – V CRYPTOGRAPHIC HASH FUNCTIONS **13 Hour**

Message Authentication, Secure Hash Algorithm, Digital signatures, Elgamal Digital Signature Scheme. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys.

Text Books

- Ivan Niven. Herbert S. Zuckerman and Hugh L. Montgomery.(2004). *An Introduction to the Theory of Numbers*, Fifth edn., John Wiley & Sons Inc.
- William Stallings,.(2017). *Cryptography and Network Security – Principles and*
- *Practice*. Pearson Education, 6th Edn.

Reference Books

- David M. Burton W.M.C. (1989). Elementary Number Theory. Brown Publishers. Dubuque, Lawa.
- George Andrews. (1994). Number Theory. Courier Dover Publications.
- William J. Leveque. (1977). Fundamentals of Number Theory. Addison-Wesley Publishing Company, Phillipines.
- C K Shyamala, N Harini, Dr T R Padmanabhan, (2011). Cryptography and Network Security. Wiley India, 1st Edition.
- Forouzan Mukhopadhyay ,.(2011). Cryptography and Network Security. Mc Graw Hill, 3rd Edition.
- Atul Kahate, (2017). Cryptography and Network Security. Mc Graw Hill, 3rd Edition.

COURSE OUTCOMES

CO No.	**The student will be able to**	**Cognitive Level**
CO 1	Recall the Divisibility and congruences.	K1
CO 2	Understand the Primitive Roots and power residues.	K2
CO 3	Test different types of security codes and their techniques.	K3
CO 4	Compare the algorithms required for public key cryptography.	K4
CO 5	Construct cryptographic and number-theoretic algorithms.	K5

FUNCTIONAL ANALYSIS
PMAM405

Semester : IV **Credit : 5**
Category : Core XVII **Hours/Week : 6**
Class &Major: II M. Sc. Mathematics **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Recall the topological-algebraical structures and properties of banach spaces.
CO-2	Recognize the Banach spaces, the spectral theorem and some of its applications.
CO-3	Apply the Hilbert Space in Normal and Unitary Operators.
CO-4	Find the fixed point theorem and spectral theorem of banach algebras.
CO-5	Evaluate the structure of commutative Banach algebras.

UNIT-I BANACH SPACES **16 Hour**

Definition –Some examples-Continous Linear Transformation –The Hahn-banach theorem-The natural embedding of N in N^{**}.

UNIT-II BANACH SPACES AND HILBERT SPACES **16 Hour**

Open Mapping Theorem-Conjucate of an operator-Definition and some simple properties-Orthogonal sets.

UNIT-III HILBERT SPACES **16 Hour**

Conjucate space H^*-Adjoint of operator-Self-adjoint operator-Normal and Unitary Operators-Projections.

UNIT-IV PRELIMINARIES ON BANACH ALGEBRAS **15 Hour**

Definition and some examples-Regular and single elements-Topological divisors of zero-Spectrum-The formula for the spectral radius-The radical and semi-simplicity.

UNIT-V STRUCTURE OF COMMUTATIVE BANACH ALGEBRAS **15 Hour**

Gelfand Mappping-Application of the formula $r[x]=\lim \| x^n \|^{1/n}$-Involutions on Banach Algebras-Gelfand-Neumark Theorem.

Text Book

- G.F.Simmons, (1963). *Introduction to topology and Modern Analysis.* McGraw Hill international Book Company,New York.

Reference Books

- Bachman & L.Narici, (1966). *Functional Analysis.* Academic Press, New york.
- E.Kreyszig. (1978). *Introduction of Functional Analysis with Application.* Johu Wiley & Sons, New York.
- Goffman. H.C., Fredrick, G., (1987). *First course in Functional Analysis,* Prentice Hall of India, New Delhi.
- W.Rudin, (1963). *Functional Analysis,* Tata McGraw Hill Book Company , New Delhi.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Describe the fundamental properties of banach spaces.	K1
CO 2	Implement Operator theory of Operators on a Hilbert space.	K2
CO 3	Test the notions of dot product and Hilbert space.	K3
CO 4	Analyse the spectral theorem to the resolution of integral equations.	K4
CO 5	Create the fixed point theorem to solve differential equations and integral equations.	K5

PROBABILITY THEORY

PMAM410

Semester : IV **Credit : 5**
Category : Core XVIII **Hours/Week : 6**
Class &Major : II M.Sc Mathematics **Total Hours : 78**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Recall the concepts of Probability.
CO-2	Recognise the Conditional probability and expectation.
CO-3	Calculate discrete probability distributions by applying probability laws and theoretical results.
CO-4	Calculate and interpret joint distribution function.
CO-5	Evaluate moment generating Functions and weak law of large numbers..

UNIT-I **16 Hour**

Basic concepts – Sample space and events – Axioms of probability – Some simple propositions – equally likely outcomes – Probability as a continuous set function - Probability as a measure of belief.

UNIT- II **16 Hour**

Conditional probabilities – Baye‟s formula – Independent events – P(./F) is a probability – random variables – Expectation of a function of a random variable – Bernoulli, Binomial and Poisson random variables.

UNIT-III **15 Hour**

Discrete probability distributions – Geometric, Negative Binomial and Hypergeometric random variables – the zeta (z;pf) distribution – continuous random variables – the uniform and normal random variables – exponential random variables – other continuous distributions – the distribution of a function of a random variable.

UNIT-IV **15 Hour**

Joint Distribution functions – Independent random variables – Their sums – conditional distribution – Joint probability distribution of functions – expectation – variance – covariance – conditional expectation and prediction.

UNIT-V **15 Hour**

Moment generating function – general definition of expectation – limit theorems – Chebyshev‟s inequality – weak law of large numbers – central limit theorems – the strong law of large numbers – other inequalities.

Text Book

- Sheldon Ross, (2008). *A First Course in Probability*. Maxwell Macmillan International Edition, Maxmillar, New York, 6th Edition.

Reference Books

- K.L.Chun, (1974). A Course in Probability Academic Press, New York.
- R.B.Ash,(1972). Real Analysis and Probability. Academic Press, New York.
- R.Durrett, "Probability Theory and Examples", (2nd Edition) Duxbury press.
- V.K.Rohatgi, (1983). An Introduction to Probability Theory And Mathematical Statistics, (3rd Edition) Wiley Eastern LTd., New Delhi.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Discuss the formulation of modern Probability Theory.	K1
CO 2	Interpret conditional probability models and function of random variables based on single & multiples random variables.	K2
CO 3	Examine and apply the concept of discrete and continuous random variable.	K3
CO 4	Select the concept of joint distribution function.	K4
CO 5	Develop the specific applications to moments generating functions.	K5

NUMERICAL ANALYSIS
PMAM409

Semester : IV **Credit : 5**
Category : Core XVIII **Hours/Week : 7**
Class &Major: II M.Sc Mathematics **Total Hours : 91**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Recall the concepts of Transcendental and polynomial equations.
CO-2	Recognise the system of linear algebraic equations and eigen value problems.
CO-3	Calculate interpolation and approximation.
CO-4	Find the concept of differentiation and integration through numerical methods
CO-5	Evaluate the concept of integration for solving ordinary differential equations. .

UNIT – I TRANSCENDENTAL AND POLYNOMIAL EQUATIONS 18 Hour

Rate of convergence – Secant Method – Regula Falsi Method – Muller Method – Chebyshev Method. Polynomial equations: Descartes' Rule of Signs – Iterative Methods: Birge-Vieta method – Bairstow's method Direct Method – Graeffe's root squaring method.

UNIT - II SYSTEM OF LINEAR ALGEBRAIC EQUATIONS AND EIGEN VALUE PROBLEMS 19 Hour

Error Analysis of Direct methods – Operational count of Gauss elimination, Vector norm, Matrix norm, Error Estimate. Iteration methods - Jacobi iteration method – Gauss Seidel Iteration method – Successive Over Relaxation method – Convergence analysis – iterative methods for A^{-1} – Optimal Relaxation parameter for the SOR method. Eigen values and Eigen vectors – Jacobi method for symmetric matrices – Power methods only.

UNIT - III INTERPOLATION AND APPROXIMATION 18 Hour

Hermite Interpolations – Piecewise and Spline Interpolation – Piecewise Linear Interpolation – Piecewise Quadratic Interpolation – Piecewise Cubic Interpolation – Spline Interpolation- Quadratics Spline Interpolation – Cubic Spline Interpolation. Bivariate Interpolation – Lagrange Bivariate Interpolation. Least Square Approximation.

UNIT - IV DIFFERENTIATION AND INTEGRATION 18 Hour

Numerical Differentiation – Optimum Choice of Step-length – Extrapolation methods – Partial Differentiation – Numerical Integration – Methods based on undetermined coefficients : Gauss Legendre Integration method and Lobatto Integration Methods only.

UNIT - V ORDINARY DIFFERENTIAL EQUATIONS 18 Hour

Single Step Methods: Local Truncation Error or Discretization Error – Order of a Method – Runge-Kutta Methods – Explicit Runge–Kutta Methods – Minimization of Local Truncation Error – System of Equations – Implicit Runge-Kutta Methods. Stability Analysis of Single Step Methods (RK Methods Only).

Text Book

- M.K. Jain, S.R.K. Iyengar and R.K. Jain, (2012). *Numerical Methods for Scientific and Engineering Computation*, New Age International (p) Limited Publishers, New Delhi, Sixth Edition.

Reference Books

- Kendall E. Atkinson, (1988). An Introduction to Numerical Analysis, II Edn., John Wiley & Sons.
- M.K. Jain, (1983). Numerical Solution of Differential Equations, II Edn., New Age International Pvt Ltd.
- Samuel. D. Conte, Carl. De Boor, (1983). Elementary Numerical Analysis, Mc Graw-Hill International Edn.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Identify the Transcendental and Polynomial equations.	K1
CO 2	Describe the error analysis, error estimate and Power method.	K2
CO 3	Examine and apply the concept of least square approximation.	K3
CO 4	Select the concept of Numerical integration and numerical differentiation for research.	K4
CO 5	Develop the applications on ordinary differential equations.	K5

DIFFERENTIAL GEOMETRY

PMAM411

Semester : IV **Credit : 5**
Category : Major Core XX / DSC XX **Hours/Week : 6**
Class &Major: II M.Sc Mathematics **Total Hour :78**

COURSE OBJECTIVES

CO No.	To enable the students
CO-1	Understand the concept of curvature of a space curve and signed curvature of a plane curve, fundamental theorem for plane curves, space curves.
CO-2	Recognise the intrinsic properties of a surface.
CO-3	Discuss the geodesics on a surface and their Characterization.
CO-4	Analyse the Second Fundamental Form and curvature.
CO-5	Formulate the Fundamental Equations of Surface Theory.

UNIT-I SPACE CURVES **16 Hour**

Definition of a Space Curve- Arc length – Tangent – Normal and Binormal – Curvature and Torsion – Contact between Curves and Surfaces – Tangent Surface – Involutes and Evolutes – Intrinsic Equations – Fundamental Existence theorem for Space curves – Helices.

UNIT-II INTRINSIC PROPERTIES OF A SURFACE **16 Hour**

Definition of a Surface – Curves on a Surface – Surface of Revolution – Helicoids – Metric – Direction Coefficients – Families of Curves – Isometric Correspondence – Intrinsic properties.

UNIT-III GEODESICS **16 Hour**

Geodesics – Canonical Geodesic Equations – Normal Property of Geodesics – Existence Theorems – Geodesic Parallels – Geodesics Curvature – Gauss Bonnet Theorem – Gaussian Curvature – Surface of Constant Curvature.

UNIT-IV NON INTRINSIC PROPERTIES OF A SURFACE **15 Hour**

The Second Fundamental Form – Principal Curvature – Lines of Curvature – Developable – Developable associated with Space Curves and with curves on surface – Minimal surfaces – Ruled surfaces.

UNIT-V FUNDAMENTAL EQUATIONS OF SURFACE THEORY **15 Hour**

Fundamental Equations of Surface Theory – Tensor Notations- Gauss Equations – Weingarten Equations - Mainardi – Codazzi Equations - Fundamental Existence theorem for Surfaces.

Text Book

- Somasundaram D. (2005). *Differential Geometry*, A First Course. Narosa Publishing House. New Delhi.

Reference Books

- Willmore. T.J. (2002). An Introuduction to Differential Geometry. Oxford University Press. (17th impression) New Delhi
- Thorpe J.A.(1979). Elementary topics in Differential Geometry Under graduate Texts in Mathematics. Springer – Verlag.
- Wilhelm Klingenberg. (1978). A course in Differential Geometry. Graduate Texts in Mathematics. Springer – Verlag.

COURSE OUTCOMES

CO No.	The student will be able to	Cognitive Level
CO 1	Recall the Fundamental Existence theorem for Space curves.	K1
CO 2	Explain the fundamentals of differential geometry primarily by focusing on the surfaces.	K2
CO 3	Examine and apply the concept of Geodesics.	K3
CO 4	Analyse the concept of Non intrinsic properties of a surface.	K4
CO 5	Develop arguments in the geometric description of curves and surfaces	K5

III & IV EVALUATION COMPONENTS OF CIA

Semester	Category	Course code	Course Title	Component III	Component IV
III	CoreXI	PMAM305	Complex Analysis	Term Paper	Seminar
	Core XII	PMAM310	Fluid Dynamics	Poster Presentation	Seminar
	Core XIII	PMAM311	Topology	Term Paper	Seminar
	Core XIV	PRMC301	Research Methodology	Term Paper	Seminar
	Core XV	PMAI312	Number Theory and Cryptography	Term Paper	Seminar
IV	Core XVII	PMAM405	Functional Analysis	Poster Presentation	Seminar
	Core XVIII	PMAM410	Probability Theory	Assignment	Seminar
	Core XIX	PMAM409	Numerical Analysis	Problem Solving	Seminar
	Core XX	PMAM411	Differential Geometry	Term Paper	Seminar