DEPARTMENT OF MATHEMATICS

PREAMBLE

UG : Programme profile and the syllabi of courses offered in the III and IV semesters along with evaluation components III and IV (With effect from 2018-2021 batch onwards) and

PG : Programme profile and the syllabi of courses offered in the III and IV semesters along with evaluation components III and IV (With effect from 2018-2020 batch onwards) are presented in this booklet.

PROGRAMME PROFILE B.Sc. (Mathematics)

PSO 1: Interpretation of effective use of mathematical skills to solve quantitative problems from a wide array of authentic contexts.

PSO 2: Ability to apply rigorous mathematical arguments in axiomatic and non-axiomatic systems.

PSO 3: Demonstration of effective written communication of mathematical concepts.

PSO 4: Capacity to formulate and develop mathematical arguments in a logical manner

Semester	Part	Category	Course code	Course Title	Contact Hrs/ week	Credit	
						Min	Max
I	I	Language	UTAL105/ UTAL106/ UHIL101/ UFRL101	Basic Tamil-I/Advanced Tamil-I/Hindi-I / French-I	4	2	3
	II	English	UENL107/ UENL108	General English-I/ Advanced English-I	5	3	4
	III	Core I	UMAM103/ UMAM107	Fundamentals of Mathematics	2	1	1
	III	Core II	UMAM104	Differential calculus	5	4	4
	III	Core III	UMAM106	Analytical Solid Geometry	6	5	5
	III	Allied	UMAA111	Mathematical Statistics	6	5	5
	IV	Value Education			2	1	1
TOTAL					**30**	**21**	**23**
II	I	Language	UTAL205/ UTAL206/ UHIL201/ UFRL201	Basic Tamil II/ Advanced Tamil-II/ Hindi-II /French-II	4	2	3
	II	English	UENL207/ UENL208	General English II/ Advanced English II	5	3	4
	III	Core IV	UMAM204	Integral Calculus	5	5	5
	III	Core V	UMAM402 /	Graph Theory	5	4	4
	III	Core VI	UMAM606/ UMAM206	Discrete Mathematics	5	4	4

	IV	Non Major Elective			4	2	2
	IV	Soft Skill			2	1	1
	V	Extension Programme/ Physical Education			-	1	2
				TOTAL	**30**	**22**	**25**
III	I	Language	UTAL305/ UTAL306/ UHIL301/ UFRL301	Basic Tamil III/ Advanced Tamil-III/ Hindi-III /French-III	4	2	3
	II	English	UENL307/ UENL308	Basic English III/ Advanced English III	5	3	4
	III	Core VII	UMAM306	Differential Equations	5	4	4
	III	Core VIII	UMAM307	Introduction to Probability Theory	5	5	5
	III	Allied	UCSA303	Mathematical Programming in C	3	3	3
	III	Allied Practical	UCSR305	Mathematical Programming in C Practical	3	2	2
	IV	Online Course (NPTEL/ SP)	UMAV301		3	1	2
	IV	Value Education			2	1	1
				TOTAL	**30**	**21**	**24**
IV	I	Language	UTAL405/ UTAL406/ UHIL401/ UFRL401	Basic Tamil IV/ Advanced Tamil-IV/ Hindi-IV/French-IV	4	2	3
	II	English	UENL407/ UENL408	Basic English IV/ Advanced English IV	5	3	4
	III	Core IX	UMAM405	Applications of Transforms	4	3	3
	III	Core X	UMAM406	Mechanics	4	4	4
	III	Core XI	UMAM404	Mathematical modeling	4	4	4
	III	Core XVIII	UMAP501/ UMAR511	Project / R Programming	2	**--**	**-**
	III	Allied	UPHA402	Electronics for Mathematics	3	3	3
		Allied Practical	UPHR404	Electronics for Mathematics Practical	2	2	2
	IV	Soft Skill			2	1	1
	V	Extension program me/ Physical Education			-	-	2
				TOTAL	30	22	26
V	III	Core XIII	UMAM501	Modern Algebra	6	6	5
	III	Core XIV	UMAM505	Real Analysis I	6	5	5
	III	Core XV	UMAM510	Number Theory	6	5	5
	III	Core XVI	UMAM510	Numerical Methods	3	3	3
		Core XVII	UMAR501	Numerical Methods Using R Programming	3	2	2
	III	Core XVIII	UMAP501/	Project/ R Programming	4	4	5

			UMAR511				
	IV	Value Education			2	1	1
				TOTAL	**30**	**25**	**26**
VI	III	Core XIX	UMAM610	Linear Algebra	5	5	5
	III	Core XX	UMAM611	Real Analysis II	6	6	6
	III	Core XXI	UMAM602/ UMAM507	Complex Analysis	6	6	6
	III	Core XXII	UMAM613	Operations Research	6	6	6
	III	Major Elective	UMAM614	Mathematics in Space Science	5	4	4
			UMAO606	Mathematics for construction craft	5	4	4
	III	Comprehensive Viva	UMAC601				
	IV	Soft Skill					
	V	Extension programme/ Physical Education			-	-	2
				TOTAL	**30**	**29**	**31**
				GRAND TOTAL	**180**	**140**	**156**

ALLIED COURSES OFFERED TO OTHER DEPARTMENTS

Class & Major	**Semester**	**Category**	**Course Code**	**Course Title**	**Contact Hrs/ week**	**Credit**	
						Min	**Max**
I B Com & I B Com (CA)	I	Allied	UMAA112	Business Mathematics	5	4	4
I B.SC PHY			UMAA104/ UMAA304	Mathematics for Physics-I/ Algebra, Differential Calculus and Trigonometry	5	5	5
I BCA			UMAA110	Mathematical Methods I	5	4	4
I B.Sc (CS) & I B.Sc ISM			UMAA113	Statistical Methods	6	4	4
I B.Sc (CS)	II		UMAA218	Mathematics for computer Science	6	4	4
II BCA			UMAA216	Mathematical Methods II	5	4	4
I B.SC PHY			UMAA212	Mathematics for Physics-II	5	5	5
II B.Sc Chem	III		UMAA304/ UMAA104	Algebra, Differential Calculus and Trigonometry/ Mathematics for Physics-I	5	5	5
II B.Sc BIO			UMAA305	Bio-Statistics	5	4	4
II BBA/ II B.COM/ II B.COM CA			UMAA211/ UMAA403/ UMAA107/ UMAA301	Business Statistics	5	4	4

II B.Sc Chem	IV		UMAA406	Integral Calculus, Laplace Transform And Ordinary Differential Equations	5	5	5
II BBA			UMAA505/ UMAA410	Quantitative techniques for Business	5	4	4

NON-MAJOR ELECTIVE

Semester	Part	Category	Course Code	Course Title	Contact Hrs/ week	Credit
II	IV	Non Major Elective	UMAE204	Basic Mathematics for Science	4	2
			UMAE202	Mathematics for Business and Decision Making	4	2
			UIDE302/ UMAE302/ UMAE206	Numerical Methods using C++	4	2
			UMAE402/ UMAE306	Operations Research for Managers	4	2
			UMAA501/ UMAE305 UMAE207	Statistical Data Analysis through SPSS	4	2
			UMAE309/ UMAE208	Applied Mathematics	4	4

EXTRA CREDIT EARNING PROVISION

Semester	Part	Category	Course code	Course Title	Contact Hrs/ 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 UMAS601 UMAS602 UMAS603	Project Fourier Transforms Simulation Number Theory	2	-	2

UMAM306 DIFFERENTIAL EQUATIONS

Semester : III **Credits : 4**
Category : Core VII **Hours/Week : 5**
Class & Major : II B.Sc. Mathematics **Total Hours : 65**

Objectives

To enable the students

- Understand linear, non- linear ordinary and partial differential equations.
- Classify the Differential Equations.
- Formulate differential equations in geometrical and physical problems.

UNIT – I FIRST ORDER DIFFERENTIAL EQUATIONS 13 Hrs

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 12 Hrs

Homogeneous Equations with constant co-efficient – Fundamental solutions of linear homogeneous equations – linear Independence and the Wronskian.

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

Complex roots of the characteristic Equation – Repeated roots; Reduction of Order – Non-Homogeneous Equations; Method of undetermined Co-efficient – Variation of Parameters.

UNIT – IV LINEAR PARTIAL DIFFERENTIAL EQUATIONS 15 Hrs

Introduction – Origin of partial differential equations – Lagrange's method – Working rule for solving Pp+Qq=R by Lagrange's method.

UNIT – V NON-LINEAR PARTIAL DIFFERENTIAL EQUATIONS 12 Hrs

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) – Standard form III only p, q and z present – Standard form IV Equations of the form $f_1(x,p) = f_2(y,p)$

Text Books

- Boyce-Diprima, "*Elementary Differential Equations*", John Wiley & sons, Inc, Newyork 2008.
- Raisinghania.M.D, *"Ordinary and Partial Differential Equations"*, New Delhi.S.Chand and Co 2008.

Reference Books

- Grewal.B.S, *"Higher Engineering Mathematics"*, New Delhi. Khanna Publishers, 2002.
- Narayanan.S & Manickavachagom Pillay, T.K "*Differential Equations and its Applications*"**,** Vishwanathan.S Printers & Publishers pvt ltd., Chennai, 2006.
- Venkatraman.M.K *"Engineering Mathematics"*, Chennai, Part B National Publishing Company 1999.

UMAM307 INTRODUCTION TO PROBABILITY THEORY

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

Objectives

To enable the students

- Understand basic ideas and concepts of probability theory.
- Compute conditional probability and conditional expectations.
- Apply Markov chain for solving real life problems.

UNIT – I INTRODUCTION TO PROBABILITY THEORY **12 Hrs**

Introduction – Sample space and Events – Probabilities defined on events – Conditional Probabilities – Independent events – Bayer's Formula.

UNIT – II RANDOM VARIABLES **12 Hrs**

Joint Probability distributed random Variable – Distribution of the number of the number of events that occur – Limit theorem.

UNIT – III CONDITIONAL PROBABILITY **13 Hrs**

Introduction – Discrete Case – Continuous Case – Computing Expectations by Conditions.

UNIT – IV CONDITIONAL EXPECTATION **14 Hrs**

Computing Probability by Condition – A List Model – A Random Graph – Uniform Priors, Polya's Urn Model, and Bose – Einstein Statistics – Mean Time for Patterns – The k-Record Values of Discrete Random Variables – Left Skip Free Random Walks – An identity for Compound random variables

UNIT – V MARKOV CHAINS **14 Hrs**

Introduction – Chapman Kolmogorov equation – Classification of States – Limiting Probability

Text Book

- Sheldon M. Ross,"*Introduction to probability models",* Elsevier Publication,10th Edition, 2010.

Reference Books

- Breiman.L, *" Probability "* Addision – Wesley , Reading , Massachusettu , 1968.
- Feller.W , " *An Introduction to Probability Theory and its Application*" Volume 1 , John Wiley, New York, 1957.

UMAM405 APPLICATIONS OF TRANSFORMS

Semester	**: IV**	**Credits**	**: 3**
Category	**: Core IX**	**Hours/Week**	**: 4**
Class & Major	**: II B.Sc. Mathematics**	**Total Hours**	**: 52**

Objectives

To enable the students

- Acquire knowledge of Transformation techniques.
- Analyse various Transformations.
- Solve difference equations and differential equations using transforms.

UNIT- I FOURIER SERIES **11Hrs**

Periodic Functions – Bounds of a Function –Continuity of a function – Fourier series – Dirichlet's conditions – Bernoulli's generalized formula of integration by parts – Even and odd functions – Half- range series – Change of interval

UNIT- II FOURIER TRANSFORMS **11Hrs**

Definition – Fourier Integral theorem – Complex Fourier transform – Inversion theorem for complex Fourier transform – Properties of Fourier Transforms – Convolution theorem – parseval's identity – Infinite Fourier Sine and Cosine transforms (without proof) – Properties of Fourier Transforms – Fourier transform derivatives – Applications of to boundary value problems.

UNIT - III LAPLACE TRANSFORMS **10Hrs**

Laplace transforms – Inverse Laplace transforms – Laplace transforms of derivatives of integrals – Applications to solution of differential equations.

UNIT-IV Z-TRANSFORMS **10Hrs**

Definition, example and Properties of Z-transform – The Inverse Z-transform – Convolution theorem – Z- transform of rational functions.

UNIT-V SOLUTIONS OF DIFFERENCE EQUATIONS BY USING Z-TRANSFORM **10Hrs**

Power series method, partial fraction method, the inverse integral method – Volterra difference equation of convolution type – Volterra systems

Text Books

- Saber N. Elaydi*, "An introduction to Difference Equations"*, Springer Verlag New Youk, 2005.
- Kandasamy.P & Thilagavathy.K ," *Mathematics*" Volume II, IV, S.Chand Publications, 2005

Reference Books

- Narayanan.S & Manicavachagom Pillay, "*Calculus"* Volume-I, Viswanathan.S Printers & Publishers Pvt, Ltd.,Chennai,2005

UMAM406 MECHANICS

Semester	**: IV**	**Credits**	**: 4**
Category	**: Core X**	**Hours/Week**	**: 4**
Class &Major	**: II B.Sc. Mathematics**	**Total Hours**	**: 52**

Objectives

To enable the students

- Understand forces acting on a particle.
- Examine a mechanical system.
- Evaluate the trajectory of a projectile, Circular Motion.

PART – I STATICS

UNIT-I FORCES **10 Hrs**

Introduction – Forces acting at a point – Parallelogram of forces – Triangle of forces – Lami's theorem, Simple Problems.

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

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) **11 Hrs**

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 **11 Hrs**

Motion of Projectile, Nature of trajectory, Results Pertaining to the motion of the Projectile, Simple Problems, Impulse force, Newton's experimental Law, Direct and oblique Impact of two smooth spheres, Impact of a smooth sphere on a fixed smooth plane Simple Problems.

UNIT - V CENTRAL ORBITS **10 Hrs**

Motion under action of Central forces and Central Orbit, equation of a central orbit, Finding law force and speed of a given orbit the law of force, Simple problems

Text Book

- Duraipandian.P, Laxmi Duraipandian and Muthamizh Jayapragasam, "*Mechanics"*, S.Chand& Co Pvt.Ltd, New Delhi,2006.

Reference Books

- Chatterji.P.N, "*Statics"*, Rajhans Publications, Meerut,1996.
- Loney.S.L, "*Elements of Statics"*, Macmilan India, New Delhi, 1982.
- Joseph F. Shelley. "*Vector Mechanics for Engineers*" Volume - I: Dynamics, Tata MC Graw Hill edition, New Delhi.2005.

UMAM404 MATHEMATICAL MODELING

Semester	**: IV**	**Credit**	**: 4**
Category	**: Core XI**	**Hours/Week**	**: 4**
Class & Major	**: II B.Sc. Mathematics**	**Total hours**	**: 52**

Objectives

To enable the students

- Classify mathematical models involving differential equations, difference equation, dynamics and graph theory.
- Analyze the mathematical models in real life problems.
- Apply the mathematical models in real life problems.

UNIT – I GROWTH AND DECAY MODELS USING ODE 10 Hrs

Ordinary differential equation – Linear growth model – Growth of science and scientists – Non- linear growth and decay models – Diffusion of glucose or a medicine in the bloodstream.

UNIT – II MODELING IN POPULATION DYNAMICS 10 Hrs

Modeling in population dynamics – Prey-predator models – Competition models – Multi-species models – Modeling of epidemics – Simple epidemic models – A model for diabetic-mellitus

UNIT – III MODELING OF PLANETARY MOTION USING SECOND ORDER ODE 10 Hrs

Modeling in second order O.D.E – Modeling of planetary motion – Motion under central force – Circular motion – Elliptic motion of a satellites – Rectilinear motion.

UNIT – IV MODELING THROUGH DIFFERENCE EQUATIONS 11 Hrs

Modeling through difference equations – Linear difference equation – Obtaining complementary function by use of matrices – Harrod model – Cob-web model – Applications of Actuarial science.

UNIT – V MODELING THROUGH GRAPHS 11 Hrs

Modeling through graphs – Seven bridge problem – Representing results of tournament – Genetic graph – Food web – Communication network – Matrices associated with a directed graph – Detection of clique – Terms of signed graph.

Text Book

- Kapur J. N, "*Mathematical Modeling"*, Wiley Eastern Limited, New Age International Pvt. Ltd., Reprint 2013.

Reference Books

- Kapur J. N, "*Mathematical Models in Biology and Medicine"*, Oscar Publications, New Delhi, 1985.
- Olink R, "*Mathematical Models in Social and Life Sciences"*, Wiley Publications 2014.

UMAR511 R PROGRAMMING

Semester	**: IV & V**	**Credits**	**: 4**
Category	**: Core XVIII**	**Hours/Week**	**: 2+4**
Class & Major	**: II & III B. Sc. Mathematics**	**Total Hours**	**: 78**

Objectives

To enable the students

- Develop the basic knowledge of the R language.
- Understand the concept of R programming.
- Develop a new programme.

UNIT -I INTRODUCTION TO R 13Hrs

Introduction to R Programming- Download, Install and Setup R & R Studio - Working with Data in R - Creating Vectors, Matrices, Lists, Data Frames and performing some simple operations on them

UNIT- II DATA IN R 13Hrs

Flow control – Looping – Conditional Statements and Branching - Essentials of R Programming - R Operators - Input and Output in R - Implementation of Program Flow in R - Working with Variables and Data in R.

UNIT- III MEASURE OF CENTRAL TENDENCY 17Hrs

Summary Statistics – Measuring Central Tendency – Mean, Median and other Quantiles, Mode – Measuring Location via Standard Scores

UNIT- IV STANDARD DEVIATION 17Hrs

Measuring Variability – Variance and Standard Deviation, Range, Median and Mean Absolute Deviation, Interquartile Range, Coefficient of Variation – Measuring Symmetry

UNIT -V GRAPHS 18Hrs

Bar Charts and Pie Charts in R - Boxplots and Boxplots With Groups in R - Histograms in R - Stem and Leaf Plots in R - Line Graphs in R - Stacked Bar Charts, Clustered Bar Charts and Mosaic Plots in R – Scatter plots in R - Modifying Plots in R - Adding Text to Plots in R - Adding Legends to Plots in R

Text Books

- Mark Gardener, "*Beginning R -The Statistical Programming Language"*, Wiley Publications, 2015
- Larry Pace, *Beginning R – An Introduction to Statistical Programming*, Apress, 2012 (www.it-ebooks.info)

References Books

- W. John Braun and Duncan J. Murdoch, "*A First Course in Statistical Programming with R"*, Cambridge University Press, 2007

Lab Exercise

1. Creating a Vector, Performing Vector Arithmetic, Adding Elements to a Vector
2. Creating a Matrix, Referring to Matrix Rows and Columns, Matrix Manipulation
3. Creating a List, Creating a Data Frame from Vectors, Reading a Table into a Data Frame, Dealing with Missing Data in R
4. Finding Pythagorean Triples, Solving Quadratic Equations

5. Measuring Central Tendency

6. Measuring Variability

7. Covariance and Correlation, Measuring Symmetry

8. Creating Frequency Distributions and Tables.

9. Creating Pie Charts and Bar Charts, Box plots, Histograms.

10. Creating Line Graphs, Scatter plots, Saving and Using Graphics

ALLIED COURSES OFFERED TO OTHER DEPARTMENTS

UMAA304 ALGEBRA, DIFFERENTIAL CALCULUS & TRIGONOMETRY

Semester : III **Credit : 5**
Category : Allied **Hours/Week : 5**
Class & Major : II B.Sc. Chemistry **Total Hours :65**

Objectives
To enable the students

- Acquire in-depth knowledge about Binomial, Exponential and Logarithmic Series.
- Understand the fundamentals of differentiation.
- Apply the techniques in their respective major subjects.

UNIT-I ALGEBRA **15 Hrs**

Binomial theorem for rational index – Exponential and Logarithmic series – summation and simple approximations related to Binomial, Exponential and Logarithmic series.

UNIT-II MATRICES **13 Hrs**

Cayley Hamilton theorem – verification – finding inverse of a matrix using Cayley Hamilton theorem – Eigen values and Eigen vectors.(simple problems only for matrices of order upto3 $\times$ 3).

UNIT-III DIFFERENTIAL CALCULUS **10 Hrs**

Successive differentiation – Leibenitz theorem and its applications – Jacobian- Concept of polar coordinates radius of curvature in Cartesian coordinates

UNIT-IV TRIGONOMETRIC SERIES **12 Hrs**

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 **15 Hrs**

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

Text Books

- Narayanan and Manicavachagom Pillay, "*Algebra Volume I"*, Viswanathan.S Publishers & Printers Pvt. Ltd., Chennai,1996.
- Narayanan and Manicavachagom Pillay, "*Calculus Volume I"*, Viswanathan.S Publishers & Printers Pvt. Ltd., Chennai, 1994.
- Narayanan.S & Manicavachagom Pillay.T.K, "*Trigonometry"*, Vishwanathan.S Printers & Publishers Pvt,Lltd., Chennai, 1994.

UMAA305 BIO-STATISTICS

Semester : IV **Credit : 4**
Category : Allied **Hours/week : 4T+1P=5**
Class & Major: II B.Sc. Bio-Chemistry **Total Hours : 65**

Objectives
To enable the students

- Understand and Practice Statistical Methods
- Apply Statistical techniques for Bio-Sciences.
- Gain analyzing skill in the Field of Experimentation in Biology and Genetics.

UNIT–I STAGES OF STATISTICAL SURVEY AND AVERAGES (12+5) Hrs

Nature and scope of Statistical Methods and their limitations – Collection, Classification and Tabulation of Statistical data – Diagrammatic and Graphical representation of statistical data Measures of Central tendency – Mean, Median, Mode, Geometric Mean, Harmonic mean.

UNIT – II DISPERSION, SKEWNESS AND MOMENTS (10+4) Hrs

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 – III CORRELATION AND REGRESSION ANALYSIS (10+4) Hrs

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 – IV PROBABILITY, RANDOM VARIABLES AND EXPECTATIONS 10 Hrs

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- mathematical expectation – Chebychev's inequality-simple problems.

UNIT – V THEORETICAL DISTRIBUTIONS 10 Hrs

Standard distribution – Binomial, Poisson, normal and exponential distributions- Derivation of mean, Variance-properties- Fittings of Distributions.

Lab Exercises

1. Presentation of data – Diagrams &Graphs
2. Calculation of Measures of central tendency – Mean, Median, Mode, Geometric mean, Harmonic mean
3. Calculation of Measures of Dispersion – Range, Quartile deviation, Mean deviation , standard deviation and its relative measures and Skewness
4. Karl Pearson's correlation coefficient
5. Regression equation of X on Y & Y on X

Text Books

- Gupta S.P., "*Statistical Methods"*, Sultan Chand, 2011.
- Gupta.S.C. and Kapoor.V.K, "*Elements of Mathematical Statistics"*, Sultan Chand & sons, 2008.

Reference Books

- Gupta.S.C. and Kapoor.V.K, "*Fundamentals of Mathematical Statistics"*, Sultan and Sons, 2007.
- Snedecor G.W and Cochran W.G., "*Statistical Methods"*, Oxford Press and IBH. 2006.
- Wayne W. Daniel, *"Bio statistics"*, Sareen printing press, Delhi, 2009.

UMAA211/UMAA403 /UMAA107/UMAA301 BUSINESS STATISTICS

Semester : III **Credit : 4**
Category : Allied **Hours/week : 5**
Class & Major: II BBA/ II B.Com / II B.Com- CA **Total Hours : 65**

Objectives
To enable the students

- Describe data with descriptive statistics
- Gain knowledge of the Statistical tools related to business problems.
- Analyze the concepts for business problems.

UNIT- I STAGES OF STATISTICAL SURVEY AND AVERAGES 13Hrs

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 14Hrs

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 12Hrs

Correlation Analysis - Types of Corrleation-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 13Hrs

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 13Hrs

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., "*Statistical Methods"*, Sultan Chand & Sons, 2006

Reference Books

- Agarwal B.L., "*Basic Statistics"*,New Age International Publishers, fourth edition 2006.
- Elhance D.N and Veena Elhance and Agarwal B.M. , "*Fundamental of statistics Kitab Mahal"* , 1999.
- Pillai R.S.N and Bagavathi., "*Statistics"*, S.Chand & Company 2006.

UMAA406 INTEGRAL CALCULUS, LAPLACE TRANSFORM & ORDINARY DIFFERENTIAL EQUATIONS

Semester	**:IV**	**Credits**	**:5**
Category	**:Allied**	**Hours/Week**	**:5**
Class & Major	**: II B.Sc. Chemistry**	**Total Hours**	**:65**

Objectives

To enable the students

- Learn certain techniques in Laplace transform.
- Understand the differentiation and integration.
- Solve the applied problems.

UNIT-I INTEGRALS 15 Hrs

Integration by Substitution, Integration of rational and irrational function of the form - Properties of definite Integrals.

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

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

UNIT-III FOURIER SERIES **10 Hrs**

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

UNIT-IV LAPLACE TRANSFORM **12 Hrs**

Laplace transform of functions-Inverse Laplace transforms-Application of Laplace Transforms in solving differential equations.

UNIT-V DIFFERENTIAL EQUATIONS **13 Hrs**

Formation of partial Differential Equation-Second order differential equations with Constant co-efficient-Homogeneous linear differential equations of the second order with variable co-efficients.

Text Books

- Manicakavachagam pillai,*T.K, "Ancillary Mathematics Integral Calculus"*, S.viswanathan Publishers & Printers. 2001

Reference Books

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

UMAA505/UMAA410 QUANTITATIVE TECHNIQUES FOR BUSINESS

Semester : IV	**Credits : 4**
Category :Allied	**Hours/Week : 5**
Class & Major: II BBA	**Total Hours : 65**

Objectives

To enable the students

- Understand the various techniques of research.
- Solve real life problems in business and management.
- Enlighten on applications in management techniques.

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

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 15HRS

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 12 HRS

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

UNIT-IV GAME THEORY 10 HRS

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 PropertySimple problems.

UNIT-V NETWORK SCHEDULING BY PERT/CPM 13 Hrs

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, "*Operation Research*", Sultan Chand & Sons,Delhi, 2003.

Reference Books

- Kapoor.V.K, "*Introduction to Operation Research*" Sulthan Chand & Sons 1996.
- Sharma S.D, "*Operation Research*" Kedar Nath Ram Nath & Co 1995
- Taha.A Hamdy, "*Operation Research-An Introduction*", Prentice hallof India pvt ltd,New Delhi, 6th edition, 2000.

III & IV EVALUATION COMPONENTS OF CIA

Semester	Category	Course code	Course Title	Component III	Component IV
III	Core VII	UMAM306	Differential Equation	Assignment	Problem Solving
	Core VIII	UMAM307	Introduction to probability theory	Assignment	Problem Solving
IV	Core IX	UMAM405	Applications of Transforms	Model Building	Assignment
	Core X	UMAM406	Mechanics	Model Building	Problem Solving
	Core XI	UMAM404	Mathematical Modeling	Assignment	Poster Presentation
IV & V	Core XII	UMAP501/ UMAR511	Project / R Programming	DPA (Daily Practical assessment)	Viva-Voce

III &IV EVALUATION COMPONENTS OF CIA-Allied

Semester	Category	Course code	Course Title	Component III	Component IV
III	Allied	UMAA304/ UMAA104	Algebra, Differential Calculus and Trigonometry/ Mathematics for Physics-I	Assignment	Problem Solving
		UMAA305	Bio-Statistics	Assignment	Problem Solving
		UMAA211/ UMAA403/ UMAA107/ UMAA301	Business Statistics	Assignment	Problem Solving
IV		UMAA406	Integral Calculus, Laplace Transform And Ordinary Differential Equations	Assignment	Problem Solving
		UMAA505/ UMAA410	Quantitative techniques for Business	Assignment	Problem Solving

PROGRAMME PROFILE M.Sc. (Mathematics)

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

PSO 4: 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	Contact Hrs/ Week	Credit	
					Mini	Max
I	Core I	PMAM107	Abstract Algebra	6	4	4
	Core II	PMAM102	Real Analysis	6	4	4
	Core III	PMAM103	Ordinary Differential Equations	6	4	4
	Core IV	PMAM105	Calculus Of Variations And Integral Equations	6	4	4
	Core V	PMAM106/ PMAM407	Fuzzy Analysis	6	4	4
			TOTAL	**30**	**20**	**20**
II	Core VI	PMAM209	Linear Algebra	5	4	4
	Core VII	PMAM202	Measure and Integration	5	4	4
	Core VII	PMAM206	Partial Differential	5	4	4

			Equations			
	Core IX	PMAM204	Classical Mechanics	5	4	4
	Core X	PMAM208	Operations Research	5	4	4
	Non Major Elective			5	4	4
	Service Learning	PMAX201/ PMAX202	Mathematics for High School Students \Elementary Mathematics for Higher Secondary Students	-	1	1
			TOTAL	**30**	**25**	**25**
III	Core XI	PMAM305	Complex Analysis	5	4	4
	Core XII	PMAM310	Fluid Dynamics	6	4	4
	Core XIII	PMAM311	Topology	6	4	4
	Core XIIV	PMAM406 / PMAM313	Mathematical Statistics	6	5	5
	Core XV	PMAI312	Number Theory and Cryptography	5	4	4
	Core XX	PMAP401	Project	2	-	-
			TOTAL	**30**	**20**	**20**
IV	Core XVI	PMAM405	Functional Analysis	6	5	5
	Core XVII	PMAM309/ PMAM408	Stochastic process	6	4	4
	Core XVIII	PMAM407	Numerical Analysis	7	5	5
	Core XIX	PMAM403	Differential Geometry	6	5	5
	Core XX	PMAP401	Project	4	5	5
			Library	1	-	-
			TOTAL	**30**	**25**	**25**
			GRAND TOTAL	**120**	**90**	**90**

PROGRAMME OFFERED TO OTHER DEPARTMENTS

Semester	Category	Course Code	Course Title	Contact Hrs/ Week	Credit	
					Mini	Max
I	Core III	PCAM103	Mathematical Foundation	4	4	4
		PCSM108	Theoretical foundations for computers	6	4	4
		PCAM504	Operations Research	4	4	4
	Non Major Elective	PMAE101	LaTeX and MaTLab	3	4	4
	Practical		LaTeX and MaTLab	2		
	Non Major Elective	PMAE102	Operations Research	5	4	4
II	Core VI	PCAM206	Applied Statistics	5	4	5
	Non Major Elective	PMAE202	NET/SET/ Competitive Exam	5	5	5
		PMAE203	Discrete mathematics	5	4	4

EXTRA CREDIT EARNING PROVISION

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

PMAM305 COMPLEX ANALYSIS

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

Objectives
To enable the students

- Lay the foundation for topics in Advanced Complex Analysis.
- Develop clear thinking and analyzing capacity for research.
- Introduce the fascinating world of complex variable theory which is markedly different from analyzing of real variable.

UNIT-I THE GENERAL FORM OF CAUCHY THEOREM 15 Hrs

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 10 Hrs

Evaluation of definite integrals – Schwarz theorem – Weierstras-ps theorem – Taylor's series –Laurent series.

UNIT-III PARTIAL FRACTION AND ENTIRE FUNCTIONS 15Hrs

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

UNIT-VI RIEMANN MAPPING THEOREM 15Hrs

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

UNIT-V ELLIPTIC FUNCTIONS 10 Hrs

Simply periodic functions-Doubly periodic functions.

Text Book

- Lars V. Ahlfors, "*Complex Analysis",* 3rd Edition, New York, McGraw Hill 1979.

Reference Books

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

PMAM310 FLUID DYNAMICS

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

Objectives

To enable the students

- Understand incompressible and compressible fluid flows.
- Analyse fluid motion.
- Grasp the basic ideas of turbulence.

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

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 Hrs**

Pressure at a point in a fluid at rest – pressure at appoint in a moving fluid – condtions at a boundary of two inviscid immiscible fluids- Eluer's equations of motion – bernoulli's equation

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

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

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

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 Hrs**

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,*"Text book of Fluid Dynamics" ,* CBS Publishers & Distributors, New Delhi, 2004.

Reference Books

- Batcherlor, C.K., "*An Introduction to fluid Mechanics*" , Cambridge University Press, 2000
- Miline and Thomson L.M., "*Theoretical Hydrodynamics*", 1962.

PMAM311 TOPOLOGY

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

Objectives
To enable the students

- Introduce the main ideas and problems of topology.
- Understand topological spaces, continuous function, connectedness, countability and separation axioms.
- Apply the concept of topology in research fields.

UNIT-I METRIC SPACES **16 Hrs**

Partially ordered sets & lattices, metric spaces, definitions and examples, open sets and closed sets convergence, completeness and Baires theorem, continuous mappings, spaces of continuous function Euclidean and Unitary spaces.

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

Definitions and examples, elementary concepts, open base and open sub base, weak topologies and the function algebras. Compactness, Compact spaces, product spaces, tychonoff's theorem and locally compact spaces and compactness for metric spaces, Ascolis theorem.

UNIT-III SEPARATION **16 Hrs**

T_1 spaces Hausdroff's spaces, completely regular spaces and normal spaces,Urysohn's lemma, the Tietae Extension theorem, Uryshon's embedding theorem, the stone-Cech compactification.

UNIT-IV CONNECTEDNESS **14 Hrs**

Connected spaces, the components of a space ,totally disconnected spaces and locally connected spaces.

UNIT-V APPROXIMATION **16 Hrs**

The Weierstrass approximation theorem, the Stone-Weierstrass theorem, locally compact Hausdorff, the extended Stone-Weierstrass theorem.

Text Book

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

Reference Books

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

PMAM313 MATHEMATICAL STATISTICS

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

Objectives
To enable the students

- Understand axiomatic approach to probability theory to study some statistical characteristics, discrete and continuous functions and their properties.
- Discuss sampling theory significance tests, estimation and testing of hypothesis.
- Express the computational skill.

UNIT-I CHARACTERISTIC FUNCTIONS **16 Hrs**

Properties of characteristic functions- characteristic functions and moments-semi-invariants- characteristic function of the sum of the independent random variables-Determination of distribution function by the characteristic function- characteristic function of multidimensional random vectors-Probability generating function.

UNIT- II SOME PROBABILITY DISTRIBUTIONS **16 Hrs**

One point, two point, Binomial-Polya-Hypergeometric- Poisson(discrete) distributions-Uniform-normal gamma-Beta-Cauchy and Laplace (continuous) distribution.

UNIT-III LIMIT THEOREM **15 Hrs**

Stochastic convergence-Bernoulli law of large numbers-Convergence of sequence of distribution functions-Levy-Cramer theorem-de-Moivre Lapalace theorem-Poisson, Chebyshev, Khintchine weak law of large numbers-Lindberg Theorem-Lyapunov Theorem-Borel-Cantelli Lemma-Kolmogorov Inequality and Kolmogorov Strong law of large numbers.

UNIT-IV SAMPLE MOMENTS AND THEIR FUNCTIONS **15 Hrs**

Notion of a a sample and a statistic-Distribution functions of $\overline{X}$,S^2 and [$\overline{X}$,S^2]- χ^2 distribution-Student t-Distribution-Fisher's Z=-Distribution-Snedecor's F-distribution of sample mean from non-normal populations.

UNIT-V SIGNIFICANT TEST **15 Hrs**

Concept of statistical test-Parametric tests for small and large samples- χ^2 test. Estimation: Preliminary notion-Consistency estimation-Unbiased estimates-Sufficiency-Efficiency-Asymptotically most efficient estimates-methods of finding intervals.

Text Book

- M.Fisz, "*Probability Theory and Mathematical Statistics*", John Wilry and sons, New York,1963.

Reference Books

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

PMAI312 NUMBER THEORY AND CRYPTOGRAPHY

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

Objectives

To enable the students

- Learn about the Applications of the Theory of Numbers.
- Understand the security concepts.
- Describe the principles of public key cryptosystems, hash functions and digital signature.

UNIT - I DIVISIBILITY **13Hrs**

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 **13Hrs**

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 **13Hrs**

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 13Hrs

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 13Hrs

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, "*An Introduction to the Theory of Numbers"*, Fifth edn., John Wiley & Sons Inc, 2004.
- William Stallings, "*Cryptography and Network Security – Principles and Practice"*, Pearson Education, 6th Edition, 2017.

Reference Books

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

PMAM405 FUNCTIONAL ANALYSIS

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

Objectives
To enable the students

- Understand Banach and Hilbert Spaces.
- Understand Operator theory leading to the spectral theory of Operators on a Hilbert space.
- Analyze the operator theory on a Hilbert space.

UNIT-I BANACH SPACES **16 Hrs**

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 Hrs**

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

UNIT-III HILBERT SPACES **16 Hrs**

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

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

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 Hrs**

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, "*Introduction to topology aand Modern Analysis*", McGraw Hill international Book Company,New York,1963.

Reference Books

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

PMAM408 STOCHASTIC PROCESS

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

Objectives

To enable the students

- Understand the concepts of Stochastic process.
- Learn about Markov Chain
- Analyse and apply the stochastic models for real life probabilistic situations

UNIT - I MARKOV AND STATIONARY PROCESSES **15Hrs**

Specification of Stochastic Processes – Stationary Processes – Poisson Process – Generalizations – Birth and Death Processes – Markov Chain – Erlang Process

UNIT - II RENEWAL PROCESSES **15Hrs**

Renewal processes in discrete and continuous time – Renewal equation – Stopping time – Wald's equation – Renewal theorems

UNIT - III MARKOV RENEWAL AND SEMI – MARKOV PROCESSES **16Hrs**

Definition and preliminary results – Markov renewal equation – Limiting behavior – First passage time.

UNIT- IV BRANCHING PROCESSES **16Hrs**

Generating functions of branching processes – Probability of extinction – Distribution of total number of progeny – Generalization of classical Galton – Watson process – Continuous time Markov branching process – Age dependent branching process – Bellman – Harris process

UNIT - V MARKOV PROCESSES WITH CONTINUOUS STATE SPACE **16Hrs**

Brownian motion – Weiner process – Kolmogorov equations – First passage time distribution for Weiner process – Ornstein : Uhlenbeck process

Text Book

- Medhi. J, "*Stochastic Processes*", New Age International (P) Ltd., New Delhi, 2nd Edition, 2001.

Reference Book

- Bhat. U.N, "*Elements of Applied Stochastic Processes*", John Wiley and Sons Limited, 2nd Edition, 1984.
- Cox .D.R and Miller H.D,"*The theory of Stochastic Processes*", Methuen, London,1965.
- Ross .S. M ,"*Stochastic Processes*", Wiley, New York, 2nd Edition,1996.
- Karlin .S and Taylor.H.M, "*A First Course in Stochastic Processes*", 2nd Edition, Academic press, New York, 1975.

PMAM407 NUMERICAL ANALYSIS

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

Objectives

To enable the students

- Introduce the exciting world of programming to the students through numerical methods.
- Describe the several errors and approximation in numerical methods.
- Apply these methods to solve mathematical problems numerically.

UNIT – I TRANSCENDENTAL AND POLYNOMIAL EQUATIONS 18Hrs

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

Chapter:2, Section:2.5 &2.9.

UNIT – II SYSTEM OF LINEAR ALGEBRAIC EQUATIONS AND EIGEN VALUE PROBLEMS 19Hrs

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 of iterative methods, Optimal Relaxation parameter for the SOR method. Eigen values and Eigen vectors – Jacobi method for symmetric matrices and Power methods only.

Chapter:3, Section:3.3 to 3.5

UNIT - III INTERPOLATION AND APPROXIMATION 18Hrs

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.

Chapter:4, Section:4.5 to 4.7

UNIT - IV DIFFERENTIATION AND INTEGRATION 18Hrs

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.

Chapter:5, Section:5.2 to 5.6,5.8

UNIT - V ORDINARY DIFFERENTIAL EQUATIONS 18Hrs

Singlestep 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).

Chapter:6, Section:6.4,6.5

Text Book

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

Reference Books

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

PMAM403 DIFFERENTIAL GEOMETRY

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

Objectives
To enable the students

- Understand space curves and their intrinsic properties of a surface and geodesics further the non-intrinsic properties of surface and the differential geometry of surfaces are explored.
- Develop arguments in the geometric description of curves and surfaces.
- Apply abstract algebra and analysis to geometrical problems and facts.

UNIT I SPACE CURVES **16 Hrs**

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 Hrs**

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 Hrs**

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 Hrs**

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 DIFFERENTIAL GEOMETRY OF SURFACES **15 Hrs**

Fundamental Equations of Surface theory – Fundamental Existence theorem for surfaces- Compact surfaces whose points are umblics – Hilbert's lemma – Compact surface of constant curvature – Complete surfaces.

Text Book

- T.J. Willmore,"*An Introuduction to Differential Geometry*", Oxford University Press, (17th impression) New Delhi 2002

Reference Books

- J.A. Thorpe "*Elementary topics in Differential Geometry*," Under graduate Texts in Mathematics, Springer – Verlag 1979.
- Kobayashi.S.and Nomizu.K. "*Foundations of Differential Geometry*", Interscience Publishers, 1963
- Struik, D.T. "*Lectures on Classical Differential Geometry*", Addison – Wesley, Mass.1950
- Wilhelm Klingenberg, "*A course in Differential Geometry*", Graduate Texts in Mathematics , Springer – Verlag 1978.

PMAP401 PROJECT

Semester	**:III**	**Credits**	**: 5**
Category	**: Core XX**	**Hours/Week**	**: 2(LaTex)+4(Project)**
Class & Major	**:PMAP401**	**Total Hours**	**: 26 hours**

Objectives

To enable the students

- Understand the mathematical latex application tools
- Develop a designing skills in LaTeX
- Apply the designing skills in LaTeX

Lab Excercise

1. Creating a documents using LaTeX.
2. Understanding Text property , Text Colour.
3. Understanding Font Size.
4. Expressing Mathematical equations using LaTeX.
5. Formulate the Article.
6. Draw & insert an image in LaTeX file.
7. How to insert a graph into LaTeX document.
8. Constructing tables using LaTeX.
9. Design a question paper.
10. Prepare Bibliography and data base.
11. Prepare a research paper and letter writing.
12. Beamer presentation using LaTeX.

Text Book

- David F Griffiths and Desmond J. Higham, "*Learning LaTex"*, SIAM (Society for Industrial and Applied Mathematics) Publishers, Phidel Phia, 1996.

Reference Books

- 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.
- L. Lamport., "*LATEX: A Document Preparation System"*, User's Guide and Reference Manual. AddisonWesley, New York, second edition, 1994.

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
	CoreXIIV	PMAM406/ PMAM313	Mathematical Statistics	Assignment	Seminar
	Core XV	PMAI312	Number Theory and Cryptography	Term Paper	Seminar
IV	CoreXVI	PMAM405	Functional Analysis	Poster Presentation	Seminar
	CoreXVII	PMAM309/ PMAM408	Stochastic Process	Assignment	Seminar
	Core XVIII	PMAM407	Numerical Analysis	Poster Presentation	Seminar
	CoreXIX	PMAM403	Differential Geometry	Term Paper	Seminar