SANDIP UNIVERSITY

SANDIP UNIVERSITY

Courses of Study

2019-20

Msc Mathematics Engineering

IILP

School of Science

M.Sc (Part Time) (Mathematics) 2018-19													
Semester	Course I	Course II	Course III	Course IV	Course V	Course VI			L	T	P	C	Contact Hours
I						Code							
	L T P C	L T P C	L T P C	L T P C	L T P C	L T P C							
	4 0 0 **4**	4 0 0 **4**	3 1 0 **4**	3 1 0 **4**	4 0 0 **4**	0 0 2 **1**			18	2	2	21	22
	PC	PC	PC	PC	UC	UC							
	Advanced Calculus	Abstract Algebra	Ordinary Differential Equations	Number Theory	C- Language	Practical in C Language-I							

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School of Science

M.Sc (Part Time) (Mathematics) 2018-19

Semester	Course I				Course II				Course III				Course IV				Course V				Course VI												L	T	P	C	Contact Hours
																					Code																
	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C													
II	4	0	0	**4**	4	0	0	**4**	3	1	0	**4**	3	1	0	**4**	4	0	0	**4**	0	0	2	**1**									18	2	2	21	22
	PC				PC				PC				PC				UC				UC																
	Complex Analysis				Linear Algebra				Partial Differential Equations				Topology				Numerical Analysis				Practicalin C Language-II																

SANDIP UNIVERSITY

School of Science

M.Sc (Part Time) (Mathematics) 2018-19

Semester	Course I				Course II				Course III				Course IV				Course V				Course VI								L	T	P	C	Contact Hours
III																					Code												
	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C									
	4	0	0	**4**	3	1	0	**4**	3	1	0	**4**	3	1	0	**4**	4	0	0	**4**	0	0	2	**1**									
	PC				PC				PC				PC				UC				UC								17	3	2	21	22
	Functional Analysis				Operation Research				Graph Theory				Combinatorics				Data Structures				Practical in Data Structures												

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School of Science

M.Sc (Part Time) (Mathematics) 2018-19

Semester	Course I				Course II				Course III				Course IV				Course V												L	T	P	C	Contact Hours
IV	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C	L	T	P	C									9	1	14	17	24
	3	1	0	**4**	4	0	0	**4**	2	0	10	**7**	0	0	2	**1**	0	0	2	**1**													
	PC				UC				PC				UC				UC																
	Fluid Mechanics				Design and Analysis of Algorithms				Research Project				Practical in Design and Analysis of Algorithms				Practical in Scilab																
																											Total		62	8	20	80	90

Department Elective I					
Transportation Engineering					
Course Code	**Course**	**L**	**T**	**P**	**C**
1					3
2					3
3					3

Department Elective II					
Water Resources and Environmental Engineering					
Course Code	**Course**	**L**	**T**	**P**	**C**
1					3
2					3
3					3
4					
5					

Course	TPMT 101	Advanced Calculus								
Year	First	Semester	I					Prerequisite		Calculus
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA)**				**End Semester Examination**		**Total Marks**
L	T	P	C	CIA-1	CIA-2	CIA-3	LAB	Theory	Lab	
5	0	-	5	20	20	10	-	**50**	-	100
Max. Time, End Semester Exam (Theory) -3Hrs.										

Course Objectives

1. To study Riemann-Stieltjes integral
2. To study sequences and series of functions
3. To study calculus of functions of several variables
4. To study Lebesgue measure and measurable functions
5. To study Lebesgue integration theory.

Course Content

Unit No.	Module No.	Content	Hours
1	I	Riemann-Stieltjes integral: Definition and existence of the integral, Properties of the integral, Integration and differentiation, Integration of vector valued functions, Rectifiable curves.	10
2	I	Sequences and series of functions: Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation,	10
	II	Equicontinuous families of functions, The Stone-Weierstrass theorem	4
3	I	Functions of several variables: Linear transformations, Differentiation, The contraction principle, The inverse function theorem, The implicit function theorem, Determinants, Derivatives of higher order, Differentiation of integrals.	12
4	I	Lebesgue measure: Set functions, Construction of the Lebesgue measure, Measurable spaces, Measurable functions, Simple functions.	13
5	I	Lebesgue integral: Integration, Comparison with the Riemann Integral, Integration of complex functions, Functions of class $\mathcal{L}^2$.	13

		Total No. of Hrs	52

Beyond the Syllabus: Manifold Theory

Course Outcome	
Students should able to	
CO1	Understand Riemann-Stieltjes integral and their properties
CO2	Learn and check the convergence of sequences and series of functions.
CO3	Gain knowledge of function of several variables.
CO4	Understand new notion of Lebesgue theory

Resources	
Recommended Books	1. Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw-Hill International Editions, Singapore (1976).
Reference Books	1. H. L. Royden, Real Analysis, Macmillan, New York (1988). 2. A. W. Knapp, Basic Real Analysis, Birkhauser, Boston (2005).

Course	TPMT 102	Abstract Algebra								
Year	First	Semester	I	Prerequisite				Calculus		
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA)**				**End Semester Examination**		**Total Marks**
L	T	P	C	CIA-1	CIA-2	CIA-3	LAB	Theory	Lab	
5	0	-	5	20	20	10	-	**50**	-	100
Max. Time, End Semester Exam (Theory) -3Hrs.										

Course Objectives

1. To revise groups, cyclic groups, permutation groups, group homomorphism
2. To study important theorems like Lagrange's theorem, Sylow theorem
3. To revise rings, Ideals, Integral Domains, ring homomorphism
4. To study polynomial rings, Irreducibility, Tests for irreducibility in detail
5. To study basic concepts of field

Course Content

Unit No.	Module No.	Content	Hours
1	I	Prerequisites: Group, subgroup, elementary results, cyclic groups, permutation groups, alternating groups, normal subgroups, group homomorphism, Isomorphism, automorphism	10
2	I	Cosets and Lagrange's theorem, orbits and stabilizer, class equation, external direct product, normal subgroups and factor groups,	6
	II	Internal direct product, finite abelian groups(fundamental theorem), Sylow theorems.	6
3	I	Prerequisites: Rings, Ideals, Integral Domains, ring homomorphism, Prime and Maximal Ideals	10
4	I	Polynomial rings, Irreducibility (Eisenstein's criterion), factorization of polynomials, PID, UFD, ED, polynomials over UFD	10
5	I	Introduction to Fields: Definition of field, Algebraic & transcendental elements, Extension field, the degree of field extension, finite	10

		extension, algebraic extension, splitting field, properties of algebraic extension, definition of finite fields and elementary results	
		Total No. of Hrs	52

Beyond the Syllabus: Galois theory

Course Outcome	
Students should able to	
CO1	Understand basic knowledge of groups and their properties.
CO2	Understand basic knowledge of ring and their properties.
CO3	Understand basic knowledge of field and their properties
CO4	Learn the concept of homomorphism and isomorphism of group and ring

Resources	
Recommended Books	1. P.B.Bhattacharya, S.K.Jain,S.R.Nagpaul, Basic Abstract Algebra , Second Edition- Cambridge Publication 2. Joseph A. Gallian , Contemporary Abstract Algebra , Fourth Edition- Narosa Publication
Reference Books	1. I.N.Herstein , Topics In Algebra , Second Edition , Wiley Publication2. David S. Dummit , Richard M. Foote , Abstract Algebra , Third Edition-Wiley Publication 2. I.S.Luthar , I.B.S. Passi, Algebra-Volume 1 and 2 , Narosa Publication

Course	TPMT-103	Ordinary Differential Equation								
Year	First	Semester	I				Prerequisite	Calculus		
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA)**				**End Semester Examination**		**Total Marks**
L	T	P	C	CIA-1	CIA-2	CIA-3	LAB	Theory	Lab	
4	1	-	5	20	20	10	-	**50**	**-**	100
Max. Time, End Semester Exam (Theory) -3Hrs.										

Course Objectives

1. To solve ordinary differential equations using different methods
2. To study Sturm separation theorem., Sturm's comparison theorem
3. To find power series solution of differential equations
4. To find solution of nonlinear differential equations

Course Content

Unit No.	Module No.	Content	Hours
1	I	Second order linear equations: The general solution of the homogeneous equations, Use of a known solution to find another solution, Homogeneous equations with constant coefficients. The method of undetermined coefficients. The method of variation of parameters	10
2	I	Qualitative Properties of solutions of ordinary differential equations of order two: Sturm separation theorem.	6
	II	Normal form, Standard form, Sturm's comparison theorem	4
3	I	Power Series solutions: Review of power series, Series solutions of first order equations; Second order linear equations, Ordinary points, Regular singular points, Indicial equations, Gauss's Hypergeometric equation, The point at infinity. Linear systems, Homogenous linear systems with constant coefficient. Non-linear systems, Volterra's Prey-Predator equations	12

4	I	Nonlinear equations: Autonomous systems, Critical points, Stability, Liapunov's direct method, Nonlinear mechanics, Conservative systems. The existence and uniqueness of solutions. The method of successive approximations, Picard's theorem, Systems, The second order linear equations	12
5	I	Calculus of variations: Euler's Differential equation with extremal, isoperimetric problems.	8
		Total No. of Hrs	52

Beyond the Syllabus: Numerical and graphical methods of solving ODE

Course Outcome	
Students should able to	
CO1	Find solution of ordinary differential equation of higher order by using various methods
CO2	Provide the existence and uniqueness of solution of ODE.
CO3	Understand the concept of stability and methods of successive approximation.
CO4	Learn how to extremized functionals and apply the concept to various problems.

Resources	
Recommended Books	1. G.F. Simmons : Differential equations with applications and Historical Notes, Second Edition (Mc-Graw Hill)
Reference Books	1. G. Birkhoff and G.C. Rota : Ordinary differential equations. (John Wiley and Sons) 2. E. A. Coddington : Ordinary differential equations. Prentice Hall of India. 3. S. G. Deo, V. Lakshmikantham, V. Raghvendra. Text book of Ordinary Differential Equations. Second edition.Tata Mc-Graw Hill.

Course	TPMT - 104	Probability and Random Variables								
Year	First	Semester	I					Prerequisite		Calculus
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA)**				**End Semester Examination**		**Total Marks**
L	T	P	C	CIA-1	CIA-2	CIA-3	LAB	Theory	Lab	
4	1	-	5	20	20	10	-	**50**	**-**	100
Max. Time, End Semester Exam (Theory) -3Hrs.										

Course Objectives

1. To understand theory of probability
2. To study distribution functions of random variable
3. To study mean, variance, covariance and coefficient of correlation of random variables

Course Content

Unit No.	Module No.	Content	Hours
1	I	Review of probability, Algebra of space, notion and axiom of probability, equally likely events, conditional probability, total probability, independent events	10 hrs
2	I	Random variables, distribution function, discrete random variables and probability mass function, Continuous random variable and probability density function,	10 hrs
3	I	Mean and variance of random variables, conditional distributions, multiple random variables, bi-variate random variables, joint distribution functions, joint probability mass function, joint probability density function	11 hrs
4	I	Conditional distribution, covariance and correlation coefficients, conditional means and conditional variance, N-variate random variables, special distributions	11 hrs
5	I	Functions of random variables: Functions of one random variable, Functions of two random variables, Functions of n random variables, expectations.	10 hrs

		Total No. of Hrs	52

Beyond the Syllabus: Estimation Theory

Course Outcome	
Students should able to	
CO1	Find probability of an event
CO2	Obtain distribution function of random variables
CO3	Find mean, variance, covariance and coefficient of correlation of random variables

Resources	
Recommended Books	Probability, Random Variables, & Random Processes: HWEI HSU, MaGraw Hill education, New Delhi, 2014.
Reference Books	Statistical Methods: Volume I and II, N. G. Das, Tata MaGraw Hill education, New Delhi.

Course	TPMT-201	Complex Analysis								
Year	First	Semester	II				Prerequisite	Calculus		
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA)**				**End Semester Examination**		**Total Marks**
L	T	P	C	CIA-1	CIA-2	CIA-3	LAB	Theory	Lab	
5	0	-	5	20	20	10	-	**50**	-	100
Max. Time, End Semester Exam (Theory) -3Hrs.										

Course Objectives

1. To make familiar with families of analytic functions
2. To exposed to complex integration
3. To go thorough with harmonic functions and power series expansions
4. To study singularities and maximum modulus Theorems
5. To study thorough with compactness and convergence in space of analytic function

Course Content

Unit No.	Module No.	Content	Hours
1	I	The complex Number System and topology of complex plane: The field of complex numbers, lines and half planes in complex planes, the extended plane and its spherical representation, connectedness, sequence and completeness, compactness, continuity, uniform convergence.	8
2	I	Elementary properties and examples of analytic functions: Power series, analytic functions, analytic functions as mappings, Mobius transformations, Riemann-Stieltjes integrals, power series representation of analytic functions, zeroes of an analytic function.	9
3	I	Complex Integration: The index of a closed curve, Cauchy's Theorem and integral formula, the homotopic version of Cauchy's Theorem and simple connectivity, counting zeroes, the open mapping Theorem, Goursat's Theorem	12

4	I	Singularities and maximum modulus Theorems: Classification of singularities, residues, argument principle, maximum principle, Schwarz's Lemma, convex functions and Hadmard's three circle Theorem	11
5	I	Compactness and Convergence in space of analytic function: The space of continuous function, spaces of analytic functions, spaces of meromorphic functions, Riemann mapping Theorem, Weierstrass Factorization Theorem	12
		Total No. of Hrs	52

Beyond the Syllabus: Complex Manifolds

Course Outcome	
Students should able to	
CO1	Discuss about connectedness, compactness, continuity and uniform convergence of complex functions
CO2	Find power series representation, Mobius transform and integration of analytic functions
CO3	Apply Cauchy's theorem and Formula, Goursat's Theorem.
CO4	Classify singularities and apply maximum principle, Schwarz's Lemma
	Study Meromorphic functions, Riemann mapping Theorem, Weierstrass Factorization Theorem

Resources	
Recommended Books	J.B. Conway, Functions of One Complex Variable, 2nd Edition, Narosa, New Delhi
Reference Books	1. Complex Analysis, E. Stein and Shakarchi, Overseas Press (India) Ltd., Princeton Lectures in Analysis.

	2.Lars V. Ahlfors : Complex Analysis (McGraw Hill) 3.Ruel V. Churchill / James Ward Brown : Complex Variables and Applications (McGraw Hill)

Course	TPMT-202	Linear Algebra								
Year	First	Semester	II	Prerequisite				Calculus		
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA)**				**End Semester Examination**		**Total Marks**
L	T	P	C	CIA-1	CIA-2	CIA-3	LAB	Theory	Lab	
5	0	-	5	20	20	10	-	**50**	-	100
Max. Time, End Semester Exam (Theory) -3Hrs.										

Course Objectives

1. To understand linear mapping and operations on vector spaces
2. To understand reduction of matrices to canonical forms
3. To understand Jordan forms

Course Content

Unit No.	Module No.	Content	Hours
1	I	Vector Spaces and Linear Transformation: vector spaces, subspaces, bases and dimension, coordinates, algebra of linear transformation, isomorphism, representation of transformation by matrices, linear functional, double dual, transpose of a linear transformation.	12
2	I	Polynomials: Algebra of polynomials, Lagrange's Interpolation, polynomial ideals, prime factorization of a polynomial	10
3	I	Determinants: Commutative rings, determinant functions, permutations and uniqueness of determinants, modules, multilinear functions.	10
4	I	Elementary Canonical Forms: Characteristic values, annihilating polynomials, invariant subspaces, simultaneous triangulation, simultaneous diagonalization, direct sum decompositions, invariant direct sum.	10
5	I	The Rational and Jordan Form: Cyclic subspaces and annihilators, cyclic decompositions and rational form, Jordan form, computation of invariant factors	10

		Total No. of Hrs	52

Beyond the Syllabus: Banach Spaces

Course Outcome	
Students should able to	
CO1	Find subspaces, dimension of vector space and matrix representation of linear transformation
CO2	Apply Lagrange interpolation to find polynomial
CO3	Study commutative rings , determinant functions, modules
CO4	Find Characteristic values, annihilating polynomials, invariant subspaces
	Find Jordan form, rational form and invariant subspaces of linear transformation

Resources	
Recommended Books	K. Hoffman and Ray Kunze : Linear Algebra (Pearson Education, Inc.)
Reference Books	1. P.B. Bhattacharya, S.R. Nagpaul, S.K.Jain: First Course in Linear Algebra – 2. M. Artin : Algebra (Prentice -Hall of India private Ltd.) 3. A.G. Hamilton : Linear Algebra (Cambridge University Press). 4. N.S. Gopalkrishnan : University algebra (Wiley Eastern Ltd.). 5. J.S. Golan : Foundations of linear algebra (Kluwer Academic publisher). 6. Henry Helson : Linear Algebra, (Hindustan Book Agency). 7. I.N. Herstein : Topics in Algebra, Second edition, (Wiley Eastern Ltd.)

Course	TPMT-203	Partial Differential Equation								
Year	First	Semester	II	Prerequisite				Calculus		
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA)**				**End Semester Examination**		**Total Marks**
L	T	P	C	CIA-1	CIA-2	CIA-3	LAB	Theory	Lab	
4	1	-	5	20	20	10	-	**50**	-	100
Max. Time, End Semester Exam (Theory) -3Hrs.										

Course Objectives

1. To be familiar with formulation and solution of PDE
2. To study in detail the solutions of first and second order PDE
3. To solve physical problems
4. To study the applications of PDE
5. To be thorough boundary value problems

Course Content

Unit No.	Module No.	Content	Hours
1	I	Partial Differential Equations of first order: Surface and normal, curves and tangents, formulation of Partial Differential Equations, solution of Partial Differential Equations of first order, integral surfaces passing through a given curve, Cauchy problem for first order equations, surfaces orthogonal to a given system of surfaces, compatible system of first order equations, Charpit's method	12
2	I	Partial Differential Equations of second order: Classification of second order Partial Differential Equations, canonical form for hyperbolic equation, parabolic equation and elliptic equation, adjoint operators, Riemann's method, Linear PDE with constant coefficients.	10
3	I	Elliptic Differential Equations: Occurrence of the Laplace and Poisson's equations, boundary value problems, properties of harmonic functions, separation of variables, Dirichlet's problem for a rectangle, Neumann problem for a rectangle, interior Dirichlet's problem for a	10

		circle, exterior Dirichlet's problem for a circle.	
4	I	Parabolic Differential Equations: Occurrence of diffusion equation, boundary conditions, elementary solutions of the diffusion equation, dirac delta function, separation of variable method.	9
5	I	Hyperbolic Differential Equations: Occurrence of wave equation, derivation of one dimensional wave equation, solution of one dimensional wave equation by canonical reduction, the initial value problem, D'Alembert's solution, vibrating string- variable separable solution, forced vibration- solution of nonhomogeneous equation.	11
		Total No. of Hrs	52

Beyond the Syllabus: Numerical solution of PDE

Course Outcome	
Students should able to	
CO1	Solve partial differential equation of first order using Charpit's method, compatible solution
CO2	Classify second order partial differential equations into parabolic, elliptic and hyperbolic type
CO3	Study Laplace and Poisson's equations, boundary value problems, Dirichlet's problem, Neumann problem
CO4	Study Diffusion equation, Dirac-delta function and separation of variable method
	Solve Wave equation, D'Alembert's equation

Resources	
Recommended Books	K. Sankara Rao: Introduction to partial differential equation, third edition (Prentice - Hall of India private Ltd.)
Reference Books	1.W. E. Williams: Partial Differential equations (Clarendon press-oxford) 2.E. T. Copson : Partial differential equations (Cambridge university press)

	3.I.N. Sneddon: Elements of partial differential 4. T. Amarnath : An Elementary Course in Partial Differential Equations (2nd edition) (Narosa Publishing House) 5. E. Di Benedetto, Partial Differential Equations, Birkhaüser. 6 .F. John, Partial Differential Equations, 3rd Edition, Narosa

Course	TPMT-204	Random Processes								
Year	Second	Semester	II				Prerequisite			Calculus
Teaching Scheme (Hrs/Week)				**Continuous Internal Assessment (CIA)**				**End Semester Examination**		**Total Marks**
L	T	P	C	CIA-1	CIA-2	CIA-3	LAB	Theory	Lab	
4	1	-	5	20	20	10	-	**50**	**-**	100
Max. Time, End Semester Exam (Theory) -3Hrs.										

Course Objectives

1. To understand functions of random variables
2. To familiarizes random processes
3. To analyses and processing of random processes and their application

Course Content

Unit No.	Module No.	Content	Hours
1	I	Functions of random variables and limit theorem: Moment generating functions, characteristic functions, the laws of large numbers and central limit theorem	10 hrs
2	I	Random Processes: Introduction, random processes, characterization of random processes, classification of random processes	10 hrs
3	I	Discrete-parameter Markow chains of random processes, Poisson processes, Wiener processes	12 hrs
4	I	Analysis and processing of random processes: Introduction, continuity, differentiation, integration, power spectral densities, white noise	8 hrs
5	I	Analysis and processing of random processes: Response of linear system to random input, Fourier series, Fourier transform of random processes	12 hrs

	Total No. of Hrs	52

Beyond the Syllabus: Decision Theory

Course Outcome	
Students should able to	
CO1	Understand different random processes
CO2	Differentiate, integrate random processes
CO3	Apply random processes to linear systems
CO4	Find Fourier transform of random processes

Resources	
Recommended Books	Probability, Random Variables, & Random Processes: HWEI HSU, MaGraw Hill education, New Delhi, 2014.
Reference Books	Statistical Methods: Volume I and II, N. G. Das, Tata MaGraw Hill education, New Delhi.