

**KAKATIYA UNIVERSITY**  
**M.A/M.Sc ( MATHEMATICS)**  
**Semester I/II/III/IV**  
**Scheme of Instruction and Examination**  
**(With effect from 2016-2018 batch)**

**SEMESTER-I**

Paper	Code of The paper	Title of The paper	No. of Periods (1 hr duration) per week	Internal Assessment Marks	Semester End Exam Marks			Credits (L+T+P)
					Theory	Practical	Total	
I	M1CP1	Algebra-I	6	20	80	-	100	4+1+0
II	M1CP2	Real Analysis-I	6	20	80	-	100	4+1+0
III	M1CP3	Ordinary differential equations	6	20	80	-	100	4+1+0
IV	M1CP4	Discrete Mathematics	6	20	80	-	100	4+1+0
V	M1CP5	Fundamentals of Statistics	6	20	80	-	100	4+1+0
		Seminar					25	1
							<b>Total Credits</b>	<b>26</b>

**SEMESTER-II**

Paper	Code of The paper	Title of The paper	No. of Periods (1 hr duration) per week	Internal Assessment Marks	Semester End Exam Marks			Credits (L+T+P)
					Theory	Practical	Total	
I	M2CP1	Algebra-II	6	20	80	-	100	4+1+0
II	M2CP2	Real Analysis-II	6	20	80	-	100	4+1+0
III	M2CP3	Topology	6	20	80	-	100	4+1+0
IV	M2CP4	Complex Analysis	6	20	80	-	100	4+1+0
V	M2CP5	Special Functions	6	20	80	-	100	4+1+0
		Seminar					25	1
							<b>Total Credits</b>	<b>26</b>

### SEMESTER-III

Paper	Code of The paper	Title of The paper	No. of Periods (1 hr duration) per week	Internal Assessment Marks	Semester End Exam Marks			Credits (L+T+P)
					Theory	Practical	Total	
I	M3CP1	Measure and Integration	6	20	80	-	100	4+1+0
II	M3CP2	Functional Analysis	6	20	80	-	100	4+1+0
III	M3CP3	Partial Differential Equations	6	20	80	-	100	4+1+0
IV	M3OP4(1)	Operations Research - I	6	20	80	-	100	4+1+0
	M3OP4(2)	Numerical Analysis - I						
	M3OP4(3)	Automata and Languages						
	M3OP4(4)	Advanced Complex Analysis						
	M3OP4(5)	Commutative Rings and Modules						
	M3OP4(6)	Mechanics of Solids						
V	M3OP5(1)	Computer fundamentals and Programming in C	7(4+3)	20	60	20	100	3+1+1
	M3OP5(2)	Office automation and C Language						
	M3OP5(3)	Numerical Analysis using C						
		Seminar					25	1
<b>Total Credits</b>								<b>26</b>

## SEMESTER-IV

Paper	Code of The paper	Title of The paper	No. of Periods (1 hr duration) per week	Internal Assessment Marks	Semester End Exam Marks			Credits (L+T+P)
					Theory	Practical	Total	
I	M4CP1	Advanced Linear Algebra	6	20	80	-	100	4+1+0
II	M4CP2	Graph Theory	6	20	80	-	100	4+1+0
III	M4CP3	Integral Equations and Transforms	6	20	80	-	100	4+1+0
IV	M4OP4(1)	Near Rings	6	20	80	-	100	4+1+0
	M4OP4(2)	Theory of Ordinary Differential Equations						
	M4OP4(3)	Operations Research – II						
	M4OP4(4)	Numerical Analysis – II						
	M4OP4(5)	Automata and Machines						
	M4OP4(6)	Theory of Reliability						
V	M4OP5(1)	Programming Methodology	7(4+3)	20	60	20	100	3+1+1
	M4OP5(2)	Programming in C++						
	M4OP5(3)	Applied Stochastic Process with MATLAB						
		Seminar					25	1
<b>Total Credits</b>								<b>26</b>

L →Lecture, T→Tutorial, P→Practical, M→ Mathematics, CP→Core Paper

### Summary

Semester	No.of Credits	Marks
I	26	525
II	26	525
III	26	525
IV	26	525
<b>Total</b>	<b>104</b>	<b>2100</b>

The Scheme of 1<sup>st</sup> Internal Assessment of each paper of Semester-I to IV is as follows:

**KAKATIYA UNIVERSITY**  
**M.A./M.Sc (Mathematics) (w.e.f 2016-18)**  
**1<sup>st</sup> Internal Assessment Examination**  
**Semester-I/II/III/IV**  
**Papers I/ II/ III/ IV/ V**

Time: 1 ½ Hours

Max Marks: 20.

Answer all the questions in serial order.  
All questions carry equal marks.

1. A question from unit-I
2. A question from unit-I
3. A question from unit-I
4. A question from unit-I
5. A question from unit-I
6. A question from unit-II
7. A question from unit-II
8. A question from unit-II
9. A question from unit-II
10. A question from unit-II

The Scheme of 2<sup>nd</sup> Internal Assessment of each paper of Semester-I to IV is as follows:

**KAKATIYA UNIVERSITY**  
**M.A./M.Sc (Mathematics) (w.e.f 2016-18)**  
**2<sup>nd</sup> Internal Assessment Examination**  
**Semester-I/II/III/IV**  
**Papers I/ II/ III/ IV/ V**

Time: 1 ½ Hours

Max Marks: 20.

Answer all the questions in serial order.  
All questions carry equal marks.

1. A question from unit-III
2. A question from unit-III
3. A question from unit-III
4. A question from unit-III
5. A question from unit-III
6. A question from unit-IV
7. A question from unit-IV
8. A question from unit-IV
9. A question from unit-IV
10. A question from unit-IV

The scheme of the examination of each paper of Semester I to IV is as follows.

**KAKATIYA UNIVERSITY**  
**M.A./M.Sc (Mathematics)**  
**(w.e.f 2016-2018)**  
**Semester-I/II/III/IV**  
**Papers I/ II/ III/ IV/ V**

Time: 3 Hours

Max Marks: 80/60\*

\*for papers having practical examination

Answer all Questions.  
All Questions carry equal Marks.

1. a) A short question From Unit-I.  
b) A short question From Unit-II.  
c) A short question From Unit-III.  
d) A short question From Unit-IV.
2. Answer any two of the following.  
a) From Unit-I.  
b) From Unit-I.  
c) From Unit-I.  
d) From Unit-I.
3. Answer any two of the following.  
a) From Unit-II.  
b) From Unit-II.  
c) From Unit-II.  
d) From Unit-II.
4. Answer any two of the following.  
a) From Unit-III.  
b) From Unit-III.  
c) From Unit-III.  
d) From Unit-III.
4. Answer any two of the following.  
a) From Unit-IV.  
b) From Unit-IV.  
c) From Unit-IV.  
d) From Unit-IV.

**MICP1**

**KAKATIYA UNIVERSITY**  
**M.A/M.SC. MATHEMATICS Syllabus(w.e.f. 2016-2018)**  
**Semester - I**  
**Paper – I**  
**Paper Code: M1CP1**  
**ALGEBRA – I**

**UNIT I**

Isomorphism theorems on Groups - Normal Series - Solvable groups - Nilpotent groups  
(Chapter 5 : Sec 2 and Chapter 6 of Text Book 1)

**UNIT II**

Group Action on A set : The notation of a group action on a set - Isotropy subgroups - Orbits - Application of G-sets to counting.  
Sylow Theorems: P-groups - Cauchy theorem - the Sylow theorems - Application of the Sylow theorems - Application to P-groups and the class equation - Further applications.  
(Sec 16,17,36,37 of Text Book 2)

**UNIT III**

The field of quotients of an integral domain: The construction - Uniqueness.  
Rings of Polynomials: Polynomials in an indeterminate – A review – The evaluation homomorphism - Factorization of polynomials over a field - The Division algorithm in  $F[x]$  - Irreducible Polynomials - Eisenstein criterion - Uniqueness of factorization in  $F[x]$  - Prime fields - Application to unique factorization in  $F[x]$ .  
(Sec 21,22,23,27.17 to 27.27 of Text Book 2)

**UNIT IV**

Factorization: Unique factorization domains. Every PID is a UFD. If  $D$  is a UFD then  $D[x]$  is a UFD.  
Euclidean Domains: Euclidean domains and Arithmetic in Euclidean domains.  
Gaussian Integers and Multiplicative norms.  
(Sect 45,46,47 of Text Book 2)

**Text Book:**

1. Basic Abstract Algebra by P.B. Bhattacharya, S.K.Jain, and S.R.Nagpaul, Second Edition, Cambridge University press.
2. A first Course in Abstract Algebra by John B.Fraleigh, Seventh Edition, Pearson education.

**Reference Books:**

1. Abstract Algebra by David S.Dummit, Richard M.Foote, Second edition, Wiley Student edition
2. Topics in Algebra by I.N Herstein
3. University algebra by N.Gopala Krishna.
4. Abstract Algebra by S.Lang.

**M1CP2**

**KAKATIYA UNIVERSITY**  
**M.A/M.SC. MATHEMATICS Syllabus(w.e.f 2016-18)**  
**Semester - I**  
**Paper – II**  
**Paper Code: M1CP2**  
**REAL ANALYSIS – I**

**UNIT I**

Metric Spaces: Limit points – Closed sets – Open sets – Perfect Sets – Bounded Sets – Closure of a set - Compact sets – Connected sets.

Numerical sequences in metric spaces: Subsequences – Cauchy sequence – Dia-meter of a set – Definition of complete metric space.

Continuous functions in metric spaces: Characterization of continuity in terms of open sets and closed sets, Continuity and Compactness.

(Sec 2.15, 2.16, 2.18 - 2.38, 2.44 – 2.47, 3.1, 3.2, 3.5, 3.6(a), 3.7 – 3.11(a), (b), 3.12, 4.5 – 4.8, 4.13, 4.14, 4.18, 4.19, 4.22 of Text Book)

**UNIT II**

The Riemann-Stieltjes Integral: Definitions of partition – Refinement of partition and RS-Integral, Necessary and Sufficient condition for integrability, Integral as a limit of a sum.

Integrability of continuous, Monotonic, discontinuous and composite functions.

Properties of the Integral: Integrability of sum and product of two functions – Integrability of modulus of a function – Integrators as step functions – Conversion of RS – Integral to Riemann integral.

(Sec 6.1 – 6.17, 6.19 of Text Book)

**UNIT III**

Sequences and Series of Functions: Pointwise and Uniform Convergence - Cauchy criterion for uniform convergence – Weirstrass  $M_n$  – test – Uniform convergence and Continuity – Uniform convergence and Integrability –Uniform convergence and differentiability - Equi continuous families of functions

(Sec 7.1 – 7.14, 7.16 – 7.25 of Text-book)

**UNIT IV**

Weirstrass approximation theorem – Definition of uniformly closed algebra – Stone's generalization of the Weirstrass theorem.

Power Series: Radius of Convergence – Real Power Series – Continuity and Differentiability of Power Series – Abel's theorem – inversion in the order of summation - Taylor's theorem – Identical power series.

(Sec 3.38 – 3.40, 7.26 – 7.32, 8.1 – 8.5 of Text-book )

**Text Book:**

Principles of Mathematical Analysis by Walter Rudin, McGraw – Hill, 3<sup>rd</sup> Edition

**Reference books :**

1. Mathematical Analysis by S.C.Malik and Savita Arora, S.Chand, 4<sup>th</sup> Edition
2. Mathematial Analysis by T.Apostle, Narosa.

**M1CP3**



**KAKATIYA UNIVERSITY**  
**M.A/M.Sc. MATHEMATICS Syllabus(w.e.f.2016-18)**  
**Semester – I**  
**Paper – III**  
**Paper Code: M1CP3**  
**ORDINARY DIFFERENTIAL EQUATIONS**

**UNIT I**

Integration in series : Ordinary and singular points – power series solution at ordinary point – Frobenius method – Problems on type I , type II , type III and type IV – series solution about regular singular point at infinity  
(Chapter 8: Sec 8.1 to 8.14 of Text Book 1)

**UNIT II**

Linear equations with variable coefficients – Introduction – Initial value problem for homogeneous equation – The Wronskian and linear dependence – reduction of the order of homogeneous equation – The new homogeneous equation  
(Sec 3.1 to 3.6 of Text Book 2)

**UNIT III**

Existence and uniqueness of solution of first order equation – The method of successive approximation – The Lipschitz condition – Sturm-Liouville problem – Orthogonality of eigen functions and Reality of eigen functions  
(Sec 5.4 to 5.5 of Text Book 1 and Sec 15.10 to 15.12 of Text Book 2)

**UNIT IV**

Variational problems with fixed boundaries – Euler’s equation for functional containing first order derivative and one independent variable – Extremals – functional dependent on higher order derivatives – Functions dependent on more than one independent variable – variational problem in parametric form – invariance of Euler’s equation under coordinate transformation  
(Chapter 1 of part V of Text Book 1)

**Text book**

1. Advanced differential equations, M.D. Raisingania, S.Chand Company Ltd.
2. An introduction to ordinary differential equations by E.A. Coddington  
Prentice-Hall of India Pvt. Ltd.

**Referene books :**

1. Differential equations with applications and Historical notes by George F. Simmons
2. Theory of ordinary differential equations by Somasundaram – Narosa.

**KAKATIYA UNIVERSITY**  
**M.A/M.Sc. MATHEMATICS Syllabus(w.e.f. 2016-18)**  
**Semester - I**  
**Paper – IV**  
**Paper code: M1CP4**  
**DISCRETE MATHEMATICS**

**UNIT I**

Fundamentals of Logic : Fundamentals of logic-Logical inferences - Methods of proof of an implication – First order logic and other methods of proof - Rules of inference for propositions - Elementary Combinatorics: Rules of inference for quantified propositions.

(Sec 1.5, 1.6, 1.7, 1.8 up to De Morgan Laws, 1.9 of Text Book 1)

**UNIT II**

Enumerating combinations and permutations with repetitions- Enumerating permutations with constrained repetitions- The principle of inclusion and exclusion.

(Sec 2.1 to 2.5, 2.8 of Text Book 1)

**UNIT III**

Recurrence relations: Generating function of sequences – Calculating coefficients of generating functions- Recurrence relations-Solving recurrence relations by substitution and generating functions-the method of characteristic roots – solutions of inhomogeneous recurrence relations.

(Sec 3.1 to 3.6 of Text Book 1)

**UNIT IV**

Boolean Algebras: Boolean algebras – Boolean polynomials – Disjunctive and Conjunctive normal forms – Black Box method – Switching circuits and applications

(Sec 8.1 to 8.4 of Text Book 2)

**Text Book:**

1. Discrete Mathematics for Computer Scientists and Mathematician by J.L.Mott, A.Kandel, and T.P. Bakel.
2. Discrete Mathematics and Graph Theory by Bhavanari Satyanarayana and Kuncham Syam Prasad, 2<sup>nd</sup> Edition, PHI Learning Pvt Limited

**Reference Books:**

1. Discrete Mathematical structures by Roden.
2. Discrete Mathematics by Kolman.
3. A Text book of Discrete Mathematics by Tremblay and Manohar.
4. Elements of Discrete Mathematics by C.L.Liu, McGraw Hill Company
5. Mathematical Foundation of Computer Science by Bhavanari Satyanarayana, Pradeep Kumar TV, Mohiddin Shaw, B S Publications

**KAKATIYA UNIVERSITY**  
**M.A/M.Sc. MATHEMATICS Syllabus(w.e.f.2016-18)**  
**Semester - I**  
**Paper – V**  
**Paper Code: M1CP5**  
**FUNDAMENTALS OF STATISTICS**

**UNIT I**

Moments–Pearson’s  $\beta$  and  $\gamma$  coefficients -Skewness and Kurtosis  
 Probability Definitions–Addition Theorem-Conditional probability - Multiplication Law of probability - Baye’s Theorem - Random Variables - Probability mass function – Probability density function.

(Chapter 2, 3, 4.2, 5.1 to 5.5.5 of Text Book)

**UNIT II**

Mathematical Expectation – Expectation of a function of a random variable – Addition and Multiplication theorem of expectation - Expectation of linear Combination of random variables – Covariance – Variance of linear combination on of random variables – Moment generating function – Chebychev’s inequality – Correlation –Karl Pearson’s coefficient of Correlation- Linear regression.Angle between two regression lines.

(Chapter 6.1 to 6.6.1, 7.1, 7.1.2, 7.5,10.1 to 10.4.2, 11.1 to 11.2.3 of Text Book)

**UNIT III**

Discrete Distributions - Bernoulli distribution – Moments of Bernoulli distribution – Binomial distribution – Moments - Moment generating function of Binomial distribution – Additive property of Binomial distribution - Poisson distribution – Moments of Poisson distribution – Geometric distribution –Lack of memory property.

(Chapter 8.1 to 8.4.1, 8.4.4 to 8.4.7, 8.5, 8.5.2, 8.5.3, 8.5.5, 8.5.8, 8.7 to 8.7.3 of Text Book)

**UNIT IV**

Continuous Distributions -Normal Distribution – Characteristics of Normal Distribution and normal probability curve - Moments of Normal Distribution – Area property- Gamma Distribution - Moment generating function of Gamma Distribution – Exponential distribution- Moment generating function of Exponential distribution- Lack of memory property.

(Chapter 9.1, 9.2, 9.2.2 to 9.2.5, 9.2.7 to 9.2.11, 9.5, 9.5.1, 9.5.3, 9.8, 9.8.1 of Text Book)

**Text Book:**

Fundamentals of Mathematical Statistics by S.C. Gupta & V.K.Kapoor, 11<sup>th</sup> Edition

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**M.A/M.Sc. MATHEMATICS Syllabus(w.e.f.2016-18)**  
**Semester - II**  
**Paper – I**  
**Paper Code: M2CP**  
**ALGEBRA - II**

**UNIT I**

Algebraic Extensions of Fields: Adjunction of roots - Algebraic extensions - Algebraically closed fields.

(Chapter 15: Sect 2, 3, 4 of the Text Book )

**UNIT II**

Normal and Separable extensions: Splitting fields - Normal extensions - Multiple roots - Finite fields - Separable extensions.

(Chapter 16 of the Text Book )

**UNIT III**

Galois Theory : Automorphism groups and fixed fields - Fundamental theorem of Galois theory - Fundamental theorem of algebra.

(Chapter 17 of the Text Book )

**UNIT IV**

Applications of Galois theory to classical problems: Roots of unity and Cyclotomic polynomials - Cyclic extensions - Polynomials solvable by radicals.

(Chapter 18: Sec 1, 2, 3 of the Text Book )

**Text-Book**

Basic abstract algebra by P.B. Bhattacharya, S.K.Jain and S.R. Nagpaul, 2<sup>nd</sup> Edition, Cambridge University press

**Reference Books:**

1. A first course in abstract algebra by J.B. Fraleigh.
2. Algebra by S. Lang
3. Topics in algebra by T.N. Herstein
4. University algebra by Gopala Krishna.
5. Abstract Algebra by David S.Dummit, Richard M.Foote, Second edition, Wiley Student edition

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**M.A/M.Sc. MATHEMATICS Syllabus(w.e.f.2016-18)**  
**Semester - II**  
**Paper – II**  
**Paper Code: M2CP2**  
**REAL ANALYSIS-II**

**UNIT I**

Fourier Series: Definition of Fourier Series and orthogonal systems of functions – Minimum property of partial sums – Bessel's inequality – Dirichlet kernel – A theorem on point wise convergence of Fourier Series – Parseval's theorem – Fejer theorem and Point wise version of Fejer theorem(In Exercise 12-16 Problems)

(Chapter 8: Sec 8.9 to 8.14, 8.16 of Text Book 1)

Improper Integrals – I: Convergence at the left and right end – Convergence at both the end point – General case – Convergence at  $\infty$  and  $-\infty$  - General case – The necessary and sufficient condition for the convergence of the improper integral  $\int_a^{\infty} f(x) dx$  - Comparison test – A useful comparison integral – Convergence of Beta function – General test for convergence – Absolute convergence

(Chapter 9: Sec 9.1 to 9.5 of Text Book 2)

**UNIT II**

Improper Integrals – II: Convergence of  $\int_a^{\infty} f(x) dx$  - A useful comparison integral – Convergence of Gamma function – General test for convergence – Absolute convergence – Abel's and Dirichlet's theorems

(Chapter 9: Sec 9.6 to 9.9.2 of Text Book 2)

Functions of Several Variables – I: Definition of Limit and Continuity of real valued functions – Intermediate value theorem – Convex sets – Partial derivatives – Existence of directional derivatives – Mean value theorem

Differentiability: Necessary and sufficient condition for differentiability – Partial derivatives of higher order

(Chapter 12, Chapter 13: Sec 13.1 to 13.6 of Text Book 2)

**UNIT III**

Functions of Several Variables – II: Schwarz's and Young's theorem - Taylor's theorem – Extreme values

Invertible and Implicit Functions: Definition of locally invertible transformations – Jacobian of transformation – Linear transformations – Statement of inverse function theorem – Implicit function theorem for the case of two variables and its applications for the existence of unique solutions of equations

(Chapter 13: Sec 13.6.1, 13.7 to 13.9, Chapter 14 of Text Book 2)

**UNIT IV**

Integrals as Functions of a Parameter: Definite integral as function of a parameter – Theorems on continuity and inversion of differentiation and integration – Limits of

integration as functions of  $y$  – Inversion of the order of integration - Uniform convergence of improper integrals – Test for uniform convergence – Inversion of the order of integration - Interchange of differentiation and integration

The Gamma Function: Definition of Gamma function and its properties – Beta function and its connection with Gamma function

(Chapter 15 of Text Book 2, Chapter 8: Sec 8.17 to 8.21 of Text Book 1)

**Text Book:**

1. Principles of Mathematical Analysis by Walter Rudin, McGraw Hill.
2. A Course of Mathematical Analysis by Shantinayakan and Mittal, S.Chand Publications

**Reference Books:**

1. Mathematical Analysis by Tom Apostol, TMH
2. Principles of Real Analysis by S.C.Malik and Savitha Arora, Newage International

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**M.A/M.Sc. MATHEMATICS Syllabus(w.e.f.2016-18)**  
**Semester - II**  
**Paper –III**  
**Paper Code: M2CP3**  
**TOPOLOGY**

**UNIT I**

Topological spaces: The definition and examples - Elementary concepts - Open bases and Open-sub bases - Weak topologies. If  $f$  and  $g$  are real or complex continuous functions defined on a topological space then  $f+g$ ,  $f.g$  and  $\alpha g$  ( $\alpha$ , scalar) are continuous. Any uniform limit of continuous functions is continuous.

(Chapter 3 : Sec 16 to 20 of the Text Book)

**UNIT II**

Compactness: Compact spaces - Products of spaces - Tychonoff's theorem - Generalized Heine-Borel theorem - Compactness for metric spaces.

(Chapter 4 : Sec 21 to 24 of Text Book)

**UNIT III**

Separation:  $T_1$ -Spaces and Hausdorff spaces - Completely regular spaces and normal spaces - Statements of Uryshon's lemma and Tietz-extension theorem.

(Chapter 5 : Sect 26 to 28 of Text Book)

**UNIT IV**

Connectedness: Connected spaces - The Components of a space - Totally disconnected spaces.

(Chapter 6 : Sec 31 to 33 of Text Book)

**Text Book:**

Introduction to Topology and Modern Analysis by G. F. Simmons, Tata McGraw-Hill

**Reference Books:**

1. Topology by James R. Munkres, 2<sup>nd</sup> Edition, Pearson Education, Asia(2001).
2. Introduction to General Topology by K.D.Joshi, Wiley Eastem.
3. Topology by J.L.Kelly, Van Nostrad, Princeton.
4. Elements of General Topology by S.T. HU, Holden day Inc.;

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**M.A/M.Sc. MATHEMATICS Syllabus(w.e.f.2016-18)**  
**Semester - II**  
**Paper – IV**  
**Paper Code: M2CP4**  
**COMPLEX ANALYSIS**

**UNIT I**

Origin of complex numbers – Basic algebraic properties – Different types of representations – Conjugates – Modulus – Roots of complex numbers – Regions in complex plane

(Sec 1 to 11 of Text Book)

(No question is to be set from this part)

Functions of complex variable – Limits – Continuity – Derivatives – Differentiation formulas – Cauchy-Riemann equations – Sufficient condition for differentiability – Polar coordinates

(Sec 12, 15, 16, 18, 19, 20, 21, 22, 23 of Text Book)

**UNIT II**

Analytic functions – Harmonic functions – Derivatives of functions  $W(t)$  – Definite integrals  $W(t)$  – Cantours – Cantour integrals – Upper bounds for moduli of Cantour integrals – ML inequality – Anti derivatives – Cauchy-Goursat theorem – Simply and Multiply connected domains

(Sec 24, 25, 26, 37, 38, 39, 40 to 49 of Text Book)

**UNIT III**

Cauchy integral formula – An extension of the Cauchy integral formula – Some consequences of the extension – Liouville's theorem – Fundamental theorem of algebra – Maximum modulus principle – Convergence of sequences – Convergence of series – Taylor series – Laurent series - Isolated singular points – Residues – Cauchy Residue theorem

(Sec 50 to 63, 68, 69, 70 of Text Book)

**UNIT IV**

The three types of isolated singular points – Residues of Poles – Examples – Zeros of analytic functions(Theorem 1 only) – Zeros and Poles – Behaviour of functions – Near isolated singular points – Evaluation of improper integrals - Argument principle – Roche's theorem – Examples

(Sec 72 to 79, 86 to 87 of Text Book)

**Text Book:**

Complex Variables and Applications by J.W.Brown and R.V.Churchill, 8<sup>th</sup> Edition.

**Reference Books:**

1. Complex Variables by H.Silverman
2. Complex Variables by J.N.Sharma
3. Complex Variables by M.L.Khanna



**KAKATIYA UNIVERSITY**  
**M.A/M.Sc. MATHEMATICS Syllabus(w.e.f.2016-18)**  
**Semester - II**  
**Paper – V**  
**Paper Code: M2CP5**  
**SPECIAL FUNCTIONS**

**UNIT I**

Legendre's equation and its solution – Legendre's function of the first kind – Generating function for Legendre polynomials – Orthogonal properties of Legendre's polynomials – Recurrence relations – Beltrami's result – Rodrigues's formula – Legendre's series for a polynomial Expansion of function  $f(x)$  in a series of Legendre's polynomial – Even and odd function

(Chapter 9: Sec 9.1 to 9.3, 9.8 to 9.10, 9.13 to 9.19 of Text Book)

**UNIT II**

Bessel's equation and its solution – Bessel's function of the first kind of order  $n$  – List of important results of Gamma function and beta function – Bessels's function of the second kind of order  $n$  – Recurrence relations – Generating function for Bessels's function  $J_n(x)$  – Orthogonality of Bessels's function – Bessel-series or Fourier Bessel expansion of  $f(x)$ .

(Chapter 11: Sec 11.1 to 11.5, 11.6A, 11.7, 11.7A, 11.7B, 11.8, 11.10, 11.11A of Text Book)

**UNIT III**

Hermite's equation and its solution – Hermite polynomial of order  $n$  – Generating function for Hermite polynomials – Alternative expressions for the Hermite polynomials – Hermite polynomials  $H_n(x)$  for some special values of  $n$  – Evaluation of values of  $H_{2n}(0)$  and  $H_{2n+1}(0)$  – Orthogonality properties – recurrence relations

(Chapter 12 of Text Book)

**UNIT IV**

Laguerre's equation and its solution – Laguerre polynomial of order (or degree)  $n$  – Alternative definition of Laguerre polynomial of order (or degree)  $n$  – Generating function for Laguerre polynomials – Alternative expression for the Laguerre polynomials – First few Laguerre polynomials – Orthogonal properties of Laguerre polynomials – Expansion of a polynomial in a series of Laguerre polynomials – Relations between Laguerre polynomials and their derivatives.

(Chapter 13 of Text Book)

**Text Book:**

1. Advanced Differential Equations- M.D. Raisinghania

**KAKATIYA UNIVERSITY**  
**M.A/M.Sc. MATHEMATICS syllabus(w.e.f. 2016-18)**  
**Semester - III**  
**Paper – I**  
**Paper Code: M3CP1**  
**MEASURE AND INTEGRATION**

**UNIT I**

Algebra of sets – Borel sets

Measurable Sets: Outer Measure - Properties of Outer Measure - Measurable Sets and Lebesgue Measure - Properties of Measurable Sets - Sequences of Measurable sets - A Nonmeasurable Set.

(Sec 1.4, 2.7, Chapter 3: Sec 1 to 4 of the Text Book)

**UNIT II**

Measurable Functions: Properties of Measurable Functions - Sequences of Measurable Functions - Almost everywhere concept - Measurability of a Characteristic Function - Simple and Step Functions - Egoroff's Theorem.

Lebesgue Integral: The Riemann Integral - The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure - The necessary and sufficient condition for measurability of bounded function - Properties of integral of bounded measurable functions - Bounded convergence Theorem.

(Chapter 3: Sec 5 to 6 and Chapter 4: Sec 1 to 2 of the Text Book)

**UNIT III**

The Lebesgue in Integral of a Nonnegative Function: Properties of Integral of Nonnegative functions - Fatou's Lemma - Monotone Convergence Theorem - Some propositions related to Integrals - The General Lebesgue Integral - Properties of Lebesgue Integrals - Lebesgue Dominated Convergence Theorem.

(Chapter 4: Sec 3 to 4 of the Text Book)

**UNIT IV**

Differentiation and Integration: Statement of Vitali Covering lemma - The four Dini's derivatives of a function – Functions of bounded variation - A theorem on integral of a differentiable function - Differentiation of an Integral - Absolute Continuity.

(Chapter 5: Sec 1 to 4 of the Text Book)

**Text Book:**

Real Analysis by H.L.Royden, PHI, 3<sup>rd</sup> Edition

**Reference Books:**

1. Measure Theory by P.R.Halmos, Van Nostrand, Princeton.
2. An Introduction to Measure and Integration by Inder K. Rana, Narosa Publications.

**KAKATIYA UNIVERSITY**  
**M.A. / M.Sc. MATHEMATICS Syllabus(w.e.f. 2016-18)**  
**Semester –III**  
**Paper –II**  
**Paper Code: M3CP2**  
**FUNCTIONAL ANALYSIS**

**UNIT I**

Banach Spaces: The definition and some Examples - Continuous Linear Transformations - The Hahn-Banach Theorem - The Natural imbedding of  $N$  in  $N^{**}$

**UNIT II**

The Open Mapping Theorem - The Conjugate of an Operator.  
Hilbert Spaces: The Definition and some Examples - Orthogonal Complements.

**UNIT III**

Orthonormal Sets - The Conjugate Space  $H^*$  - The Adjoint of an Operator - The Self-Adjoint Operators.

**UNIT IV**

Normal and Unitary Operators – Projections - The Spectral Theorem.

**Text Book :**

Introduction to Topology and Modern Analysis by G.F. Simmons.

**Reference Books:**

1. Functional Analysis by G. Backmann and Narici
2. Functional Analysis by P.K. Jain IP, Ahuja and Khalil Ahmed.
3. Introductory Functional Analysis with Applications by E. Kreyszig.
4. Functional Analysis by B.V. Limaye.
5. A First Course in Functional Analysis by G. Goffman and G. Pedick Prentice Hall of India.

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus(w.e.f.2016-18)**  
**Semester –III**  
**Paper –III**  
**Paper Code: M3CP3**  
**PARTIAL DIFFERENTIAL EQUATIONS**

**UNIT I**

Formation of First Order Partial Differential Equations – Solution of Linear First Order Partial Differential Equations (Langrange’s Method)- Integral Surfaces Passing Through a Given Curve - Surfaces Orthogonal to a Given System of Surfaces-Compatibility of First Order Partial Differential Equations – Classification of the Solutions of First Order Partial Differential Equations - Solutions of Non-Linear Partial Differential Equations of First Order – Charpit’s Method - Jacobi’s Method - Special Types of First Order Equations – Cauchy’s Method of Characteristics.

**UNIT II**

Second order Partial Differential Equations – Origin – Linear Partial Differential Equations with Constant Coefficients - Methods of Solving Linear Partial Differential Equations – Classification of Second Order Partial Differential Equations - Classification of Second Order Partial Differential Equations - Adjoint Operators- Riemann’s Method..

**UNIT III**

Derivation of Laplace equation and Poisson’s equation – Boundary Value Problems – Separation of Variable method - Laplace equation in Cylindrical and Spherical coordinates - Interior and exterior Dirichlet problem for a circle – Interior Dirichlet problem for a Sphere- Interior Neumann problem for a Circle - Miscellaneous examples.

**UNIT IV**

Solution of Diffusion by Separation of Variables Method - Diffusion Equation in Cylindrical and Spherical coordinates – D’Alembert solution of one dimensional Wave Equation – Separation of Variable Method - Two Dimensional Wave Equation – Separation of Variable Method- Two Dimensional Wave Equation

**Text Book:**

Partial Differential Equations for Engineers and Scientists by J.N. Sarma and Kehar Singh Published by Narosa Publishing House.

**Reference Books:**

1. Elements of partial Differential Equations by I.N. Sneddon
2. Partial Equations by L.C Evans.
3. Partial Differential Equations by Prasad & Ravindran.

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –III**  
**Paper –IV (Elective)**  
**Paper Code: M3OP4(1)**  
**OPERATIONS RESEARCH - I**

**UNIT I**

Hyper planes – Hyper spheres – Convex sets and their properties –Mathematical formulation of a LPP - Graphical solution method- General LPP - Canonical and Standard form of a LPP. Basic solution – Degenerate solution – Basic feasible solution – Improved basic feasible solution - Optimum basic feasible solution – Fundamental properties of solutions-Reduction of a feasible solution to a basic feasible solution – Fundamental theorem of linear programming - Improved basic feasible solution - Existence of unbounded solution – Conditions of optimality – The Simplex algorithm.

**UNIT II**

Use of Artificial Variables – Two-Phase Method - Big M-Method – Degeneracy in linear programming - Duality – General Primal-Dual pair – Formulating a Dual problem – Primal-Dual pair in matrix form - Duality theorems – Duality and Simplex method - Dual simplex method.

**UNIT III**

Transportation problem- Matrix form of T.P. – special case of LPP Transportation table-Initial Basic Feasible Solution – North West Corner Rule, Matrix - Minima Method, Vogel approximation method of finding initial basic feasible solution – loops in a T.P. – Transportation Algorithm of finding optimal solution - Degeneracy in T.P. – Unbalanced T.P.

**UNIT IV**

Assignment problems – Hungarian method of finding optimal assignment problems – Travelling Salesman Problem.  
 Integer programming – all & mixed integer programming problems- Gomory's All IPP method- Gemory's mixed integer programming – branch and bound method .

**Text-Book:**

Operations Research by Kanti Swarup. P.K.Gupta and Manmohan.

**Reference Books:**

1. Operations Research by Handy A.Taha. Printice Hall of India.
2. Linear programming methods and applications by Gass. S.I

**KAKATIYA UNIVERSITY**  
**M.A/M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester - III**  
**Paper – IV (Elective)**  
**Paper Code: M3OP4(2))**  
**NUMERICAL ANALYSIS - I**

**UNIT I**

Initial-Value Problems for Ordinary Differential Equations – The Elementary Theory of Initial – Value Problems – Euler’s Method – Higher-Order Taylor Methods – Runge-Kutta Methods – Multistep Methods – Stiff Differential Equations.

**UNIT II**

Iterative Techniques in Matrix Algebra – Norms of Vectors and Matrices – Eigenvalues and Eigenvectors – The Jacobi and Gauss-Seidel Iterative Techniques – Relaxation Techniques for Solving Linear Systems.

**UNIT III**

Numerical Solutions of Nonlinear Systems of Equations – Fixed Points for Functions of Several Variables – Newton’s Method – Quasi-Newton Methods – Steepest Descent Techniques.

**UNIT IV**

Boundary-Value Problems for Ordinary Differential Equations – The Linear Shooting Method – The Shooting Method for Nonlinear Problems – Finite-Difference Methods for Linear Problems – Finite-Difference Methods for Nonlinear Problems

**Text Book :**

Numerical Analysis by Richard L.Burden and J.Douglas Faires, 9<sup>th</sup> Edition, Brooks/Cole, Cengage Learning

**KAKATIYA UNIVERSITY**  
**M.A. /M.SC. MATHEMATICS Syllabus(w.e.f. 2016-18)**  
**Semester –III**  
**Paper –IV(Elective)**  
**Paper Code: M3OP4(3)**  
**AUTOMATA AND LANGUAGES**

**UNIT I**

Mathematical Preliminaries: Sets, relations and functions – Graph – Trees - Strings and their properties - Principle of induction.

The theory of Automata: Definition of automation - Description of a finite automation - Transition systems.

(Chapter 1: Sec 1.1 to 1.4 and Chapter 2: Sec 2.1 to 2.2 of Text Book)

**UNIT II**

Properties of Transition functions: Acceptability of a string by a finite automation - Non deterministic finite state machines - The equivalence of DFA and NFA - Mealy and Moore models - Minimization of finite automata.

(Chapter 2: Sec 2.4 to 2.9 of Text Book)

**UNIT III**

Formal Languages: Basic definitions and examples - Chomsky classification of languages and their relations - Recursive and recursively enumerable sets - Operations on languages and automata.

(Chapter 3: Sec 3.1 to 3.6 of Text Book)

**UNIT IV**

Regular Sets and Regular Grammars: Regular expressions - Finite automata and Regular expressions - Pumping Lemma for regular sets - Applications of Pumping Lemma - Closure properties of regular sets - Regular sets and regular grammar.

(Chapter 4: Sec 4.1 to 4.6 of Text Book)

**Text Book:**

Theory Computer Science (Automata, Languages and Computation) by K.L.P. Mishra and N. Chandrasekhar, PHI

**Reference Books:**

- 1.Introductory theory of computer science by E.V.Krishna Murthy, East-West Press.
2. Theory of Finite Automates with an introduction to formal languages by Carrel J and Lang D, PHI

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –III**  
**Paper –IV (Elective)**  
**Paper Code: M3OP4(4)**  
**ADVANCED COMPLEX ANALYSIS**

**UNIT I:**

Harmonic Functions: Harmonic functions – Borel-Carathodary theorem – Poisson’s integral formula – Positive harmonic functions – Harnack’s functions – Harnack’s inequality – Harnack’s principle  
(Chapter 10: Sec 10.1 to 10.3 of Text Book)

**UNIT II:**

Conformal mappings and Bilinear transformations: Introduction – Conformality theorem – Bilinear transformations – Special bilinear transformations – Exponential and trigonometric transformations – Normal families – Montel’s theorem and Riemann mapping theorem(Statement only)  
(Chapter 11 of Text Book)

**UNIT III:**

Univalent functions: Definition of univalent functions and elementary properties – Area theorem – Coefficient conjectures – Coefficient estimates – Growth and distortion theorems – Function with positive real part  
(Chapter 12 of Text Book up to theorem 12.8)

**UNIT IV:**

Subclasses of S, Entire and Meromorphic Functions: Starlike functions – Convex Functions – Close to convex functions – Infinite products – Meromorphic functions – Weirstrass theorem  
(Chapter 12: Sec 12.2 , Chapter 13: Sec 13.1, 13.2 of Text Book)

**Text Book:**

Complex Variables by H.Silverman

**Reference Books:**

1. Complex Variables Theory and Applications by H.S.Kasana
2. Univalent Functions by P.C.Duren
3. Univalent Functions by A.W.Goodman(Vol I & II)



**KAKATIYA UNIVERSITY**  
**K.A./M.Sc MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester-III**  
**Paper-IV (Elective)**  
**Paper Code: M3OP4(5)**  
**COMMUTATIVE RINGS & MODULES**

**UNIT I**

Modules – Homomorphisms - Exact Sequences- Free modules – Vector spaces  
(Chapter 4: Sec 1 & 2 of Text Book)

**UNIT II**

Projective Modules – Injective Modules – Hom & Duality  
(Chapter 4: Sec 3 & 4 of Text Book)

**UNIT III**

Chain Conditions – Prime and Primary Ideals  
(Chapter 8: Sec 1 & 2 of Text Book)

**UNIT IV**

Primary Decomposition - Noetherian Rings and Modules – Krull Intersection Theorem –  
Nakayama lemma- Hilbert Basis Theorem.  
(Chapter 8: Sec 3 & 4 of Text Book)

**Text Book :**

Algebra by Thomas Hungerford.

**KAKATIYA UNIVERSITY**  
**M.A./M.Sc MATHEMATICS Syllabus(w.e.f 2016-18)**  
**Semester-III**  
**Paper-IV(Elective)**  
**Paper Code: M3OP4(6)**  
**MECHANICS OF SOLIDS**

**UNIT I**

Introduction to Tensors: Coordinate transformations - Summation Convention – Contravariant - Covariant and mixed tensors - Symmetric and skew symmetric tensor - Fundamental operations with the tensors - The line element and metric tensor - Tensor form of gradient, divergence and curl.

(Scope as in Text Book 1)

Analysis of Strain: Deformation - Affine transformations - Infinitesimal affine transformations - Geometrical interpretation of the components of strain - Strain quadric of Cauchy - Principal strain and strain invariants - Examples of strain - Equations of compatibility (a simple derivation).

(Chapter 1 of the Text Book 2)

**UNIT II**

Analysis of Stress: Body and surface forces - Stress tensor - Equations of equilibrium - Transformation of coordinates - Stress quadric of Cauchy - Maximum normal and shear stress - Mohr's diagram - Examples of stress.

(Chapter 2 of the Text Book 2)

**UNIT III**

Equations of Elasticity: Generalized Hooke's law - Homogeneous isotropic media - Elastic moduli for isotropic media - Simple tension - Pure shear and hydrostatic pressure - Equilibrium equations for an isotropic elastic solid - Dynamical equations for an isotropic elastic solid - The strain energy function and its connection with Hooke's law - Uniqueness of solutions.

(Chapter 3 of the Text Book 2)

**UNIT IV**

Basic Problems of Elasticity: Statement of problem - Extension of beams by longitudinal forces - Beam stretched by its own weight - Bending of beams by terminal couples - Torsion of circular shaft - Torsion of cylindrical beams - Stress function.

(Chapter 4: Sec 29-35 of the Text book 2)

**Text Book:**

1. Vector Analysis (For Unit-I, a) Introduction to Tensors) – Murray R Spiegel, Schaum's Series.
2. Mathematical Theory of Elasticity – I.S.Sokolnikoff, TMG- New Delhi.

**Reference Books:**

1. Theory of Elasticity – S.P.Timoshenco, J.N.Goodier.
2. Theory of Elasticity – PDS. Verma, Vikas Publications.

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –III**  
**Paper – V (Elective)**  
**Paper Code: M3OP5(1)**  
**COMPUTER FUNDAMENTALS AND PROGRAMMING IN C**

**UNIT I**

Major Components of a Digital Computer - Computer Classification - User Interface - Hardware Software and Firmware - LAN and WAN.  
Number System (Binary, Decimal, Octal and Hexadecimal) - Conversion of one Number System to another - Floating-Point Representation.  
(Chapters 1, 2 of Text Book 1)

**UNIT II**

Constants – Variables – Data types – Operators – Expressions – Managing input and output operations  
(Chapter 2, 3, 4 of Text Book 2)

**UNIT III**

Decision making and branching – Decision making and looping – Arrays - User defined function  
(Chapters 5, 6, 7, 9 of Text Book 2)

**UNIT IV**

Structures and unions – Pointers - File management in C.  
(Chapters 10, 11 and 12 of Text Book 2)

**Text Book:**

1. Computer Fundamentals, Architecture and Organization by B.Ram, 3<sup>rd</sup> Edition, New Age International (P) Limited.
2. Programming in ANSI C by E.Balagursamy, 4<sup>th</sup> Edition, Tata McGraw-Hill Education Pvt. Ltd.

### **Computer Lab Work**

1. Program to print Biggest of 3 given numbers.
2. Program to print the roots of a quadratic equation
3. Program to print sum of N given numbers.
4. Program to print N prime numbers.
5. Program to check whether the given number is palindrome or not.
6. Implement functions to find whether a given number is prime or not.
7. Program to find the  $n^{\text{th}}$  Fibonacci number using recursion.
8. Program to multiply two matrices
9. Program to check whether the given string is palindrome or not.
10. Program to sort a given string.
11. Create a file of student records .
12. Program to swap two numbers using pointers.
13. Program to compute sum of elements stored in an array using pointers.
14. Program to read student records (name, roll, m1, m2, m3) as structure and sort according to name.
15. Program to read student records (name, roll, m1, m2, m3) as structure and print the result.
16. . Programs i)to create a file ii) to read the created file and display it contents..

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –III**  
**Paper – V (Elective)**  
**Paper Code: M3OP5(2)**  
**OFFICE AUTOMATION AND C – LANGUAGE**

**UNIT I**

MS-Office, MS-Word – Basics – Header – Footer – Tables – Graphics – Templates – Macros.

MS-Excel – Worksheet – Formatting – Functions – Charts – Graphs – Worksheets and Data Strings.

( Text Book 1)

**UNIT II**

Overview of C – Constants - Variables and Data types - Operators and Expressions - Managing Input and Output operations.

(Chapters 1, 2, 3 and 4 of Text Book 2)

**UNIT III**

Decision making and Branching - Decision Making and Looping – Arrays - Handling Character Strings - User Defined Functions.

(Chapters 5, 6, 7, 8 and 9 of Text Book 2)

**UNIT IV**

Structures and Unions – Pointers - File Management in C.

(Chapters 10, 11 and 12 of Text Book 2)

**Text Book:**

1. Working in MS-Office – By Ron Mansfeild, Tata McGrawHill.
2. Programming in ANSI C by E.Balagurusamy, Third Edition, Tata McGraw-Hill

**Reference Book:**

MS-OFFICE For everyone by Sanjay Saxena, Vikas Publication.

### **Computer Lab Work**

1. Prepare Curriculum Vitae of a student.
2. Mail Merge.
3. Create graphs( Line, Pie and Bar) in Excel
4. Simple macros in Excel.
5. Program to print Biggest of 3 given numbers.
6. Program to print sum of N given numbers.
7. Program to check whether the given number is palindrome or not.
8. Implement functions to find whether a given number is prime or not.
9. Program to find the  $n^{\text{th}}$  Fibonacci number using recursion.
10. Program to multiply two matrices
11. Program to check whether the given string is palindrome or not.
12. Program to sort a given string.
13. Create a file of student records .
14. Program to swap two numbers using pointers.
15. Program to read student records (name, roll, m1,m2,m3) as structure and sort according to name.
16. Program to copy contents of one file to another file.

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –III**  
**Paper – V (Elective)**  
**Paper Code : M3OP5(3)**  
**NUMERICAL ANALYSIS Using C**

**UNIT I**

Transcendental and polynomial equations: Introduction - Bisection Method - Secant Method - Regula-Falsi Method - Newton-Raphson Method - Mullar Method - Chebyshev Method - Multipoint Iterative Methods - Rate of convergence  
(Chapter 2: Sec 2.1, 2.2, 2.3, 2.4 and 2.5 of the Text Book)

**UNIT II**

System of linear algebraic equations and eigen value problems: Introduction  
Direct Methods: Gauss-Elimination Method - Gauss-Jordan Method - Triangularisation Method - Cholesky Method - Partition Method - Error analysis for direct methods  
Iteration Methods: Jacobi Iteration Method - Gauss-Seidel Iteration Method - Eigen Values and Eigen Vectors - Power Method - Inverse Power Method.  
(Chapter 3: Sec 3.1, 3.2, 3.3, 3.4, 3.5, 3.11 and 3.12 of the Text Book)

**UNIT III**

Interpolation and approximation: Introduction - Lagrange Interpolation - Newton Divided Differences - Quadratic Interpolation - Higher Order Interpolation - Iterated Interpolation - Finite Differences Operators  
Interpolating Polynomials using finite differences: Gregory-Newton forward difference interpolation - Backward difference interpolation - Stirling and Bessel interpolation - Hermite interpolation - Spline interpolation  
Approximation: Least square approximation.  
(Chapter 4: Sec 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 and 4.9 of the Text Book)

**UNIT IV**

Numerical differentiation and integration: Introduction  
Numerical Differentiation: Linear interpolation - Quadratic interpolation - Methods based on finite differences - Methods Based on Undetermined Coefficients - Numerical Integration Methods Based on Interpolation: Newton-Cotes Methods - Open type integration Rules  
Composite Integration Methods: Romberg Integration - Double Integration.  
(Chapter 5: Sec 5.1, 5.2, 5.6, 5.7, 5.9, 5.10 and 5.11 of the Text Book)

**Text Book:**

Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, R. K. Jain, 5<sup>th</sup> Edition, New Age International (p) Limited Publishers

**Reference Book:**

An Introduction to Numerical Analysis by Kendall E. Atkinson

## Numerical Analysis Laboratory

The following programs are to be executed in C/Fortran language.

1. Solution of system of  $n \times n$  linear equations  $AX=B$  using Gauss Elimination method.
2. Finding solution of  $n \times n$  linear equations  $AX=B$  using LU decomposition method.
3. Finding solution of  $n \times n$  linear equations  $AX=B$  using Gauss-Seidel iteration method.
4. Finding the largest Eigen value in magnitude and the corresponding Eigen vector of an  $n \times n$  matrix A by Power method.
5. Lagrange interpolation.
6. Newton-Gregory forward interpolation.
7. Newton-Gregory backward interpolation.
8. Evaluation of the integral of  $f(x)$  between the limits 'a' and 'b' using Trapezoidal rule with 'n' subintervals.
9. Evaluation of the integral of  $f(x)$  between the limits 'a' and 'b' using Simpson's  $1/3^{\text{rd}}$  rule with '2n' subintervals.
10. Evaluation of the integral of  $f(x)$  between the limits 'a' and 'b' using Simpson's  $3/8^{\text{th}}$  rule with '3n' subintervals.
11. Solution of equation by Bisection method.
12. Solution of equation by Regula-Falsi method.
13. Solution of equation by Newton-Raphson method.
14. Solution of equation by Mullar method.

### **Text/Reference Books:**

1. Numerical methods for scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar and R. K. Jain.
2. Numerical methods by E. Balagurusamy.
3. Computer oriented Numerical methods by V. Raja Raman.



**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –IV**  
**Paper – I**  
**Paper Code: M4CP1**  
**ADVANCED LINEAR ALGEBRA**

Review of Vector Spaces, Subspaces Bases and Dimension.

**UNIT I**

Linear Transformations: The algebra of Linear Transformations – Isomorphism - Representation of Transformations by Matrices - Linear Functional - The double Dual - The Transpose of Linear Transformation.  
(Chapter 3: Sec 3.1 to 3.7 of the Text Book)

**UNIT II**

Elementary Canonical forms: Characteristic Values - Annihilating Polynomials - Invariant Subspaces – Simultaneous Triangulation – Simultaneous Diagonalization  
(Chapter 6: Sec 6.1 to 6.5 of the Text Book)

**UNIT III**

Direct-sum Decompositions - Invariant Direct sums - The primary Decomposition theorem  
The Rational and Jordan Forms: Cyclic Subspaces and Annihilators - Cyclic Decompositions and rational form - Cyclic Decomposition Theorem (without proof) - The Jordan Form  
(Chapter 6: Sec 6.6 to 6.8, Chapter 7: Sec 7.1 to 7.3 of the Text Book)

**UNIT IV**

Bilinear Forms: Bilinear forms - Symmetric Bilinear Forms - Skew Symmetric Bilinear Forms - Groups preserving Bilinear Forms  
(Chapter 10: Sec 10.1 to 10.4 of the Text Book)

**Text Book:**

Linear Algebra by Kenneth Hoffman and Ray Kunze, 2<sup>nd</sup> Edition, Pearson (2003).

**Reference Books:**

1. Finite Dimensional Vector Spaces by p.Halmos,D Vanostrand,Princeton.
2. Linear Algebra by H.Friedberg etal, PHI(2007)
3. Linear Algebra by Lipschitz, Schaum Series.

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –IV**  
**Paper – II**  
**Paper Code: M4CP2**  
**GRAPH THEORY**

**UNIT I**

Preliminary Concepts: Introduction – Types of graphs and isomorphisms – Walks, Paths and Circuits – Eulerian and Hamiltonian graphs  
(Chapter 13: Sec 13.1 to 13.4 of Text Book)

**UNIT II**

Trees – Fundamental Circuits – Cut-Sets and Cut-Vertices  
(Chapter 13: Sec 13.5 to 13.7 of Text Book)

**UNIT III**

Planarity, Colouring and Partitioning: Planar graphs and Dual graphs – Colouring and Partitioning  
(Chapter 14: Sec 14.1 to 14.2 of Text Book)

**UNIT IV**

Some algebraic aspects of graphs: Vector space of a graph – Matrix representations of graphs  
Directed graphs: Introduction – Representation of a binary relation as a graph – Directed hypercubes – Properties of a directed graph  
(Chapter 15: Sec 15.1 to 15.2, Chapter 16: Sec 16.1 to 16.3 of Text Book)

**Text Book:**

Discrete Mathematics and Graph Theory by Bhavanari Satyanarayana and Kuncham Syam Prasad, 2<sup>nd</sup> Edition, PHI Learning Pvt. Limited

**Reference Books:**

1. Graph Theory by Harary.F , Narosa Publishing House, 1995.
2. Discrete Mathematics for Computer Scientists and Mathematicians by J.L.Mott, A.Kandel and T.P.Bakel.
3. Graph Theory with Applications by Bondy.J.A. and U.S.R.Murthy, American Elsevier, New York, 2008.

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –IV**  
**Paper – III**  
**Paper Code: M4CP3**  
**INTEGRAL EQUATIONS AND TRANSFORMS**

**UNIT I**

Integral Equation – Differentiation of a Function under an Integral Sign – Relation Between Differential and integral Equations – Solution of Non-homogeneous Volterra's Integral Equations by the method of Successive Substitution and Successive Approximation of some Resolvent Kernels – Volterra Integral Equation of First Kind.

(Sec 1.1 to 2.4 of Text Book 1)

**UNIT II**

Solution of the Fredholm Integral Equation by the Method of Successive Substitution and successive approximation – Reciprocal Functions - Volterra's Solution of Fredholm's Equation – Statement of Fredholm first Theorem- Statement of Unique Solution of the Non-homogeneous Fredholm Integral Equation – Integral equations with degenerate kernels - Symmetric Kernel – Eigen value of a Symmetric kernel Real Characteristic Constants – Greens Functions – Construction of Green's Functions.

(Sec 2.5 to 2.9, 3.1, 3.2, 3.14, 4.1, 4.4, 5.6, 5.7, 5.8 of Text Book 1)

**UNIT III**

Laplace Transforms – Existence of Laplace Transform – Properties of Laplace Transform- The inverse Laplace transform and properties – Convolution Theorem- Solution of ordinary differential Equation by Laplace Transforms- Solution of Ordinary Differential Equation by Laplace Transforms- Solution of Partial Differential Equations by Laplace Transforms - Application of Laplace Transforms to Integral Equations

(Chapter 1, Chapter 2: Sec 2.1 to 2.15, Chapter 3: Sec 3.1 to 3.4, Chapter 4 of Text Book 2)

**UNIT IV**

Fourier Transforms – Fourier Integral Formula – Inversion Theorem for Complex Fourier Transform -Fourier Sine and Cosine Transform - Inversion of Formulae – Convolution Theorem- Parseval's identity -Finite Fourier Sine and Cosine Transforms - Inversion Formulae -Operational Properties – Convolution – Application of Fourier Transforms to Initial and Boundary value problems.

(Chapter 6: Sec 6.1 to 6.15, 6.17, 6.18, 6.19, Chapter 7: Sec 7.1 to 7.4, 7.6, 7.7, 7.9, Chapter 8 of Text Book 2)

**Text Book:**

1. Integral Equations by Shanty Swarup
2. Integral Transforms by A. R Vasistha and R.K. Gupta

**Reference Books:**

1. Advance Calculus for Applications by Francis B. Hilder Brand Prentic Hall of India

**KAKATIYA UNIVERSITY**  
**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –IV**  
**Paper – IV (Elective)**  
**Paper Code: M4OP4(1)**  
**NEAR RINGS**

**UNIT I**

The Structure Of Near –Rings: Near-ring - The Near-Ring of all mappings on a group  $G$  - The Near-Ring of all zero respective mappings on  $G$  - Sub-Near-Ring - Abelian Near-Ring - Commutative Near-Ring - Zero Near-Ring - Zero Symmetric Near-Ring - Constant Near-Ring - Trivial Zero Symmetric Near-Ring and Trivial Constant Near-Ring - Near-ring homomorphism and isomorphism - Ideal (left, right ) of a Near-Ring - Quotient Near-Ring - Natural homomorphism associated with an Ideal - Kernel of homomorphism - R-sub group (left, right) of a Near-Ring  $R$  - Simple Near-Ring.

(Chapter 1: Sec 1.1 to 1.40 of the Text Book)

**UNIT II**

Near-Ring Modules: R-module - Faithful representation - Centralizer Near-Ring - The right regular representation of a Near-Ring - R-sub module - Unital R-module - R-module homomorphism and isomorphism - Quotient R-module - Annihilator of a subset.

(Chapter 2: Sec 2.1 to 2.37 of the Text Book)

**UNIT III**

Primitive Near-Rings: Homogeneous Near-Ring - R-module of type 0 - R-module of type 1 - R-module of type 2 - V-primitive Near-Ring - The Stabilizer.

(Chapter 3: Sec 3.1 to 3.37 of the Text Book)

**UNIT IV**

More on 2-Primitive Near-Rings: Rank – Projection - Minimal condition - Maximal condition – DCCS – DCCR – DCCI – ACCR – ACCI

(Chapter 4: Sec 4.1 to 4.28 of the Text Book)

**Text Book:**

Near-Rings and their links with groups by J.D.P.Meldrum.

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**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –IV**  
**Paper – IV (Elective)**  
**Paper Code: M4OP4(2)**

**THEORY OF ORDINARY DIFFERENTIAL EQUATIONS**

**UNIT I**

System of Linear Differential Equations: Introduction system of First order Equations - Existence and Uniqueness theorem - Fundamental Matrix - Non Homogenous Linear System - Systems with Constant Coefficients – Linear Systems with Periodic Co-efficient  
(Chapter 4: Sec 4.1 to 4.7 of Text Book)

**UNIT II**

Existence and Uniqueness of Solutions : Introduction – Preliminaries - Successive Approximations - Picard's Theorem - Non Uniqueness of Solutions - Continuation and Dependence on initial conditions - Existence of Solutions in the large - Existence and Uniqueness of Solutions of Systems.  
(Chapter 5: Sec. 5.1. to 5.8 of Text Book)

**UNIT III**

Behavior of Solutions of linear Differential Equations : Introduction -  $n^{\text{th}}$  order - Elementary Critical Points - Critical Points of Non-Linear system - Linear Systems with Constant-coefficient - Linear Systems with variable Co-efficient - Second Order Linear Differential Equations .  
(Chapter 5 & 6 of Text Book)

**UNIT IV**

Stability Non-Linear systems : Introduction - Stability of Quasi- Linear Systems - Stability of Autonomous Systems - Stability of Non- Autonomous Systems - A special Lyapanov Function  
(Chapter 9: Sec 9.1 to 9.5 of Text Book)

**Text Book:**

Ordinary Diff. Equations and Stability Theory by S.G. Deo, V. Ragvendra and V.Laxmi Kantham.

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**Semester –IV**  
**Paper – IV(Elective)**  
**Paper Code: M4OP4(3)**  
**OPERATIONS RESEARCH - II**

**UNIT I:**

Sequencing and Scheduling: Sequencing Problem – The Problem of n Jobs and Two Machines – Problem with n Jobs and m Machines – General Problem of n Jobs and m Machines - Scheduling – Critical Path Determination by CPM – Critical Path Determination by PERT – Optimum Scheduling by CPM.  
(Chapter 7 of Text Book)

**UNIT II**

Queuing Systems – Introduction – Markov Process – Birth-Death Process – Steady State Solution – Poisson Queues – The Classical Queue System – The Finite Storage Queue System – The s-Server Case – The s-Server Case with Finite Storage – The system with Finite Population, s-Servers and Finite Storage – Responsive Servers or Self Service System.  
(Chapter 11: Sec 11.1 to 11.2F of Text Book)

**UNIT III**

Dynamic Programming – Bellman's Optimality Principle – Recursive Relations – Solution of LPP by Dynamic Programming – Dimensionality in Dynamic Programming.  
(Chapter 5: Sec 5.1 to 5.3 of Text Book)

**UNIT- IV**

Non-Linear Programming – Survey of Quadratic Forms and Classical Methods – Convex Functions and Kuhn-Tucker Theory – Convex Functions – Convex Non-Linear Programming Problem – Quadratic Programming – Beale's Method for Quadratic Programming.  
(Chapter 4: Sec 4.1 to 4.4 of Text Book)

**Text Book:**

Introduction to Optimization Operations Research by J.C.Pant(6<sup>th</sup> Edition)

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**Semester –IV**  
**Paper –IV (Elective)**  
**Paper Code: M4OP4(4)**  
**NUMERICAL ANALYSIS - II**

**UNIT I**

Partial Differential Equations – Introduction – Difference Method – Routh Hurwitz Criterion – Domain of Dependence of Hyperbolic Equations.  
(Chapter 1: Sec 1.1 to 1.4 of Text Book)

**UNIT II**

Difference Methods for Parabolic Differential Equations – Introduction – One Space Dimension – Two Space Dimensions – Spherical and Cylindrical Coordinate System.  
(Chapter 2: Sec 2.1 to 2.3, 2.5 of Text Book)

**UNIT III**

Difference Methods for Hyperbolic Partial Differential Equations – One Space Dimensions – Two Space Dimensions – First Order Equations.  
(Chapter 3: Sec 3.1 to 3.4 of Text Book)

**UNIT- IV**

Numerical Methods for Elliptic Partial Differential Equations – Introduction – Difference Methods for Linear Boundary Value Problems – General Second Order Linear Equation – Equation in Polar Coordinates.  
(Chapter 4: Sec 4.1 to 4.4 of Text Book)

**Text Book :**

Computational Methods for Partial Differential Equations by M.K.Jain, S.R.K.Iyengar, R.K.Jain, Wiley Eastern Limited, New Age International Limited, New Delhi

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**Semester –IV**  
**Paper –IV (Elective)**  
**Paper Code: M4OP4(5)**  
**AUTOMATA & MACHINES**

**UNIT I**

Context - Free Languages : Context – Free languages – Derivation Trees- Ambiguity in Context – Free Grammars – Simplification of Context – Free Grammars – Chomsky Normal Form of Context - Free Grammars – Pumping Lemma for context – Free Languages- Decision Algorithms for Context – Free Languages.

**UNIT II**

Pushdown Automata : Basic Definitions – Acceptance by Pda – Pushdown Automata and Context Free Languages- Parsing and Push Down Automata.

**UNIT III**

Turning Machines And Linear Bounded Automata: Turing Machine Model – Representation of Turing Machines – Language Acceptability by Turing Machines – Design of Turing Machines – Universal Turing Machines and their Modifications. The Model of Linear Bounded Automata – Turing Machines and Type 0 Grammars.

**UNIT IV**

Linear Bounded Automata and languages – Halting Problem of Turing Machines – NP – Completeness – LR (K) Grammars – Properties of LR(K) Grammars – Closure Properties of Languages.

**Text Book:**

Theory of Computer Science (Automata, languages and Computation) by KLP Mishra and N.Chandrasekhar, Prentice Hall of India.



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**Semester –IV**  
**Paper –V (Elective)**  
**Paper Code: M4OP4(6)**  
**THEORY OF RELIABILITY**

**UNIT I**

Fundamental concepts in Reliability Engineering – Introduction – General reliability function – General concepts – Hazard rate – reliability function – Bath tub Hazard rate curve – Mean time failure

**UNIT II**

System Reliability – Series configuration – Parallel configuration – Mixed configuration – diagrams – Maker models – Marker graphs

**UNIT III**

Failure Data Analysis – Failure data – Mean failure rate – Mean time to failure – Mean time between failures – Graphical plots – MTTF in terms of failure density – Reliability in terms of Hazard rate and failure

**UNIT IV**

Hazard Models: Constant Hazard, Linearly increasing Hazard – The Weibull model – Distribution functions and reliability analysis – density functions – Expected value – some important distributions – Standard deviation and variation

**Text Book:**

Reliability Engineering by L.S. Srinath

**Reference Books:**

Reliability Engineering by E.Balagurusamy

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**M.A. /M.Sc. MATHEMATICS Syllabus (w.e.f.2016-18)**  
**Semester –IV**  
**Paper – V (Elective)**  
**Paper Code: M4OP5(1)**  
**PROGRAMMING METHODOLOGY**

**UNIT I**

Algorithms – Data-Data types and primitive operations – Variables and Expressions - From Algorithms to Programs Decisions Structures – Looping – Use of Compound conditions – Case Statement Applications

**UNIT II**

Sub Algorithms – Argument – Parameter Correspondence – Recursive Sub algorithms – Applications composite Date Structures One- Dimensional Arrays – Sorting and Searching with Vectors – Application of Vectors.

**UNIT III**

Higher – Dimensional Arrays – Application of Arrays – Files – Linear Data Structures – Linear Lists- Storage Structure Concepts – Sequential Storage Structure for Arrays – Application of Stacks – Queues.

**UNIT IV**

Non-Linear Data Structures – Trees – General Trees – Application of Trees- Graphs.

**Text Book :**

Introduction to Computer Science by Trembay and Bunt.

**Lab Work :**

Simple programs in C on the above Structures

**Pattern of Lab Training.**

The total number of students are made into batches. The number of students in each batch should not more than students and each batch should be handled by two teachers

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**Semester –IV**  
**Paper – V (Elective)**  
**Paper Code: M4OP5(2)**  
**PROGRAMMING IN C++**

**UNIT I**

Input and Output in C++-C++ Declarative control Structures .  
(Chapters 2, 3 and 4 of Text Book)

**UNIT II**

Functions in C++ - Classes and Objects.  
(Chapters 5 and 6 of Text Book)

**UNIT III**

Constructors and Destructors – Operator Overloading and Type conversion – Inheritance  
(Chapters 7, 8 and 9 of Text Book)

**UNIT IV**

Pointers and Array – C++ and Memory – Binding , Polymorphism and Virtual Functions  
(Chapters 10, 11 and 12 of Text Book)

**Text Book:**

Object-Oriented Programming with ANSI & Turbo C++ by Ahok. N. Kamthane.

**Lab Work:**

Simple programs in C ++ on the above topics.

**Pattern of Lab Training :**

The total number of students are made into batches. The number of students in each batch should not be more than 10 students and each batch should be handled by two teachers.

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**Semester –IV**  
**Paper – V (Elective)**  
**Paper Code: M4OP5(3)**  
**APPLIED STOCHASTIC PROCESS WITH MAT LAB**

**UNIT I**

Stochastic Process: Some Notations – Introduction - Specifications of Stochastic Process - Stationary process.

(Sec 2.1, 2.2 & 2.3 of Text Book 1)

Markov chains: Definition and Examples - Transition Matrix - Order of Markov chains - Markov chain as graphs - Higher transition probabilities - Classification of States and chains – Irreducible chain - periodic chain - transient and recurrence states - first passage time distributions - stability of Markov system - Stationary distribution - Ergodicity.

(Sec 3.1, 3.2, 3.4, 3.6 of Text Book 1)

**UNIT II**

Markov Process with Discrete State Space - Poisson process - Poisson process and related distributions - Continuous Time Markov Chain (CTMC).

(Sec 4.1, 4.2 & 4.5 of Text Book 1)

**UNIT III**

Finite Markov Chains and its Applications: Finite Markov chains with recurrent & transient States - Irreducible finite Markov Chains with Ergodic states , statistical inference.

(Sec 5.1, 5.2 & 5.3 of Text Book 2)

**UNIT IV**

Stationary Process and Time Series : Introduction - Models of time series - Time and frequency domain - Power spectrum Statistical Analysis of Time Series - Some definitions

(Sec 8.1, 8.2, 8.3 & 8.4 of Text Book 1)

**Text Book:**

1. Stochastic Process by J.Medhi, Second Edition, Wiley Eastern Limited
2. Elements of Applied Stochastic Process by U.N.Bhatt, JohnWiley & Sons

**Reference Books:**

1. Stochastic Process by N.U. Prabhu, Macmillan, NewYork

## **PRACTICALS**

**(20 Marks)**

### **i) Lab Work (MATLAB)**

**(10 Marks)**

1. Basic Matrix operations
2. Computation of Eigen values & Eigen vectors.
3. Computation of steady state probability distribution using
  - a. Power method
  - b. Jacobi method
  - c. Gauss-Seidel method

### **Reference Books:**

1. Getting Started with MATLAB by Rudra Pratap, Oxford University Press.
2. Introduction to Numerical Solutions of Markov Chains by William J. Stewart, Princeton University Press.

### **ii. Case Studies**

**(10 Marks)**

Applications of finite Markov Chains in Finance and Banking, Health Care, Retail Business, Internet Traffic Modeling and other research and development areas.

Note: For the case studies, students will be divided into batches. Each batch consists of two or three students.