M. Phil.
MATHEMATICS
SYLLABUS - 2018

St. JOSEPH'S COLLEGE (Autonomous)

Special Heritage Status Awarded by UGC

Accredited at 'A' Grade (3rd cycle) by NAAC

College with Potential for Excellence Conferred by UGC

DBT-STAR & DST-FIST Sponsored College

TIRUCHIRAPPALLI - 620 002, INDIA

GUIDELINES FOR M.PHIL. PROGRAMME

1. Duration

The programme runs for one year of two semesters. The Semester- I is from August to February and the Semester- II runs from March to August, of the following year.

2. Course Work

Semester-I			Semester-II		
Course	**Title**	**Cr**	**Course**	**Title**	**Cr**
C1	Professional Skills for Teaching - Learning	4	C5	Dissertation (Topic selected should be relevant to the topic of the Guide Paper)	8
C2	Research Methodology	4			
C3	Core Course	4			
C4	Guide Paper	4			
Total		**16**	**Total**		**8**

A) Each Course should contain 5 units, covering the subject requirements of the courses offered. **Marks for CIA and SE are in the ratio 25: 75**.

CIA & SE	Tentatively on
Mid Semester Test	December 2nd week
End Semester Test	February 2nd week
Semester Examinations	February 4th week

A candidate shall be declared to have passed Course I, II, III and IV, if he / she secures not less than 40% of the marks in both CIA and the University Examination and 50% of the marks in the aggregate (i.e. continuous internal assessment and the written Examination taken together.

B) In course C1 on **'Professional Skills for Teaching– Learning'** the first three units are common to all the Departments of the College. The first three unit titles are **Soft Skills, E-teaching, E-learning, Elements of Technology ofTeaching and Learning.** The remaining two units are department specific tomake use of the above mentioned skills & techniques to teach the Core Course.

The C1 Course is (to be) designed to explore the various Teaching – Learning – Research Skills to be imbibed / cultivated to make the research

scholars to be fit for the profession they are likely to acquire in the Education Sector.

Departments will be permitted to offer either paper 2 or paper 3 as Open Online Course to the M.Phil. students. The evaluation method will be the same for both C2 and C3 Courses.

C) **Evaluation:**

C.1:

For CIA and SE there will be a 2 hour test only from the first THREE units. The CIA components are Mid Semester Test (35), End Semester Test(35) and Assignment (15) and Practical Component(15). The total mark 100 will be converted into **25** marks.

C.2, C.3 & C.4:

The CIA components for C-2, C-3 and C-4 are Mid Semester Test (25), End Semester Test (25), Seminar (30), Objective Type test /Assignment (20). *(The marks of Mid semester test (75), End semester test (75) will be converted into 25 each.)*

The total mark 100 will be converted into 25 marks. The tests and Semester Examination are centrally conducted by COE for 3 hours.

a) Question papers for C1, C2 & C3 are set by External Examiners.
b) Question paper for C4 will be set and valued by the Research Advisor only.
c) The evaluation method will be the same for both C2 and C3 Courses.

3. Credits

	Courses	Title		Contact hours	Library hours	Total hours	Credit	CIA marks	SE marks	Total marks
Semester-I	C1	Professional Skills for Teaching-Learning	T	3	2	5	3	25	50	100
			P	2	2	4	1		25	
	C2	Research Methodology		5	4	9	4	25	75	100
	C3	Core Paper		5	5	10	4	25	75	100
	C4	Guide Paper		5	5	10	4	25	75	100
Total				**20**	**18**	**38**	**16**	**100**	**300**	**400**

		Internal	Cr	Mk	External	Cr	Mk
Semester-II	C5	Seminar & Review of Related Literature	1	15	Dissertation Evaluation	6	75
		Mid-term Review Presentation	1	15	Viva-voce	2	25
		Dissertation Work	4	50			
		Publication of Research Articles	1	10			
		Viva-voce	1	10			
Total			**8**	**100**		**8**	**100**

4. Question Pattern

Course	Mid & End Semester Tests		
	SCIENCE		
C1	Section A: Short Answers Section B: Either/Or - Essay Type	7/9 3	7×2 = 14 3×7 = 21
C2	Section A: Short Answers Section B: Either/Or - Essay Type	10 5	10×3 = 30 5×9 = 45
C3	Section A: Short Answers Section B: Either/Or - Essay Type	10 5	10×3 = 30 5×9 = 45
C4	Open Choice: Comprehensive Type	5/8	5×15 = 75
	ARTS		
C1	Section A: Short Answers Section B: Either/Or - Essay Type	7/9 3	7×2 = 14 3×7 = 21
C2	Open Choice: Comprehensive Type	5/8	5×15 = 75
C3	Open Choice: Comprehensive Type	5/8	5×15 = 75
C4	Open Choice: Comprehensive Type	5/8	5×15 = 75

Course	Semester Examination		
	SCIENCE		
C1	Section A: Short Answers Section B: Either/Or - Essay Type	7/9 3	7×2 = 14 3×12 = 36
C2	Section A: Short Answers Section B: Either/Or - Essay Type	10 5	10×3 = 30 5×9 = 45
C3	Section A: Short Answers Section B: Either/Or - Essay Type	10 5	10×3 = 30 5×9 = 45
C4	Open Choice: Comprehensive Type	5/8	5×15 = 75
	ARTS		
C1	Section A: Short Answers Section B: Either/Or - Essay Type	7/9 3	7×2 = 14 3×12 = 36
C2	Open Choice: Comprehensive Type	5/8	5×15 = 75
C3	Open Choice: Comprehensive Type	5/8	5×15 = 75
C4	Open Choice: Comprehensive Type	5/8	5×15 = 75

5. Dissertation

For carrying out the dissertation, it is mandatory to strictly adhering to the rules of the college as given below:

5.1 Requirement

Every student is expected to give two seminars one concerning Review of Related Literature within the four weeks from the beginning of the second semester and the other on Data Analysis/Result/Mid Term Review just before the submission of the final draft of the dissertation

5.2 Submission

Candidates shall submit the Dissertations to the Controller of Examinations **not earlier than five months but within six months** from the date of the start of theSemester –II. The above said time limit shall start from the 1st of the month which follows the month in which Semester - I examinations are conducted. If a candidate is not able to submit his/ her Dissertation within the period stated above, he/she shall be given an extension time of **four** months in the first instance and another **four** months in the second instance with penalty fees. If a candidate does not submit his/her Dissertation even after the two extensions, his/her registration shall be treated as cancelled and he/she has to re-register

for the course subject to the discretion of the Principal. However the candidate need not write once again the theory papers if he/she has already passed these papers.

At the time of Submission of Dissertation, the guide concerned should forward the marks to the CoE through HOD in a sealed cover

5.3 Publications

All the M.Phil. Scholars should publish atleast one Research article in the reputed Journals before the submission of their dissertation. Publication of research article will be considered as CIA component. According to the type of Journals marks will be distributed to each article as follows.

UGC approved Journals	-	10 marks
Other Journals with ISSN number	-	8 marks
ReTeLL or Seminar /Conference Proceedings	-	6 marks

5.4 Requirement

For the valuation of dissertation it is mandatory to have passed in all the four courses. One external examiner and the Research Adviser shall value the Dissertation. The external examiner should be selected only from outside the college and shall be within the colleges affiliated to Bharathidasan University. In case of non-availability, the panel can include examiners from the other university/colleges in Tamil Nadu. The external examiner shall be selected from a panel of 3 experts suggested by the Research Adviser. However, the Controller of Examination may ask for another panel if he deems it necessary. Both the internal and external examiner will evaluate the Dissertation and allot the marks separately. However the *viva-voce* will be done by both of them. The average marks will be considered.

5.5 Curbing Plagiarism

According to The draft of University Grants Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Education Institutions) Regulations, 2017. Before submitting the thesis every students should submit the draft and get the certificate from the college library which will be issued after the verification of plagiarism. The certificate should be enclosed along with the thesis.

Plagiarism would be quantified into following levels in ascending order of severity for the purpose of its definition:

Level-0: Similarities upto 10% Excluded
Level-1: Similarities above 10% to 40%
Level-2: Similarities above 40% to 60%
Level-3: Similarities above 60%

Penalties for Students Plagiarism Disciplinary Authority (PDA) of the HEI, based onrecommendations of the Academic Misconduct Panel (AMP), shall impose penalty considering the severity of the Plagiarism.

i. Level 0: Similarities upto 10% - Minor Similarities, no penalty.
ii. Level 1: Similarities above 10% to 40% - Such student shall be asked to submit a revised script within a stipulated time period not exceeding 6 months.
iii. Level 2: Similarities above 40% to 60% - Such student shall be debarred from submitting a revised script for a period of one year.
iv. Level 3: Similarities above 60% -Such student registration for that programme shall be cancelled.

5.6 Viva-Voce

An open Viva-Voce examination shall be conducted by both the external examiner and the supervisor **and shall be attended by members of Department Research Committee members, all faculty members of the departments, other research scholars and other interested experts / researchers** and evaluated jointly by the Examiner and the Supervisor. The valuation of M.Phil. Dissertations and the viva-voce examination shall be carried out on the same day at the place of the Research Supervisor (viva is to be conducted only if the student passes in the valuation of the dissertation). The mark should be sent to the Controller of Examinations by the Research supervisor. A candidate shall be declared to have passed Part-II Examination if he secures not less than **55%** of the marks both in internal and external.

6. Classification of Final Results

i. The classification of final results shall be based on the CGPA, as indicated in Table 2.
ii. For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as “Outstanding”. Similarly, the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99, and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective Programmes as “Excellent”, “Very Good”, “Good”, and “Above Average” respectively..
iii. Absence from an examination shall not be taken as an attempt.

Table-1: Grading of the Courses

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above but below 90	9	A+
70 and above but below 80	8	A
60 and above but below 70	7	B+
50 and above but below 60	6	B
Below 50	NA	RA

Table-2: Final Result

CGPA	Corresponding Grade	Classification of Final Results
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-Appearance

6.1 Credit based weighted Mark System is to be adopted for individual semesters and cumulative semesters in the column 'Marks Secured' (for 100).

6.2 Candidates who have failed in the courses may take the supplementary exams conducted by the CoE immediately. Even then, if they could not complete the course(s), they will be given two more chances only to appear for those courses along with the next batch scholars. The maximum duration for the completion of the M.Phil.Programme is 2 Years.

7. **Attendance**: Daily attendance for 90 working days should be enforced for the students. Periodical report of a student to the guide concerned should be recorded in the register kept by the guide.

8. **The Scholar must obtain 80% of attendance per semester in order to appear for the Semester Examinations/*Viva-Voce.***

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M. Phil. MATHEMATICS

Programme Outcomes (POs)

1. Scholars are to be adopted with a new paradigm of self-learning in the form of review of earlier knowledge acquired.
2. Scholars are brought to light from the previous investigation completed to the newer thrusts of knowledge and implementation in research.
3. Scholars are trained to design, implement and evaluate secured information (hard and soft) systems with assured quality and efficiency.
4. Scholars are to be oriented towards becoming globally competent.

Programme Specific Outcomes (PSOs)

1. To acquire teaching and research competency.
2. To understand nuances of Advanced Abstract Mathematics.
3. To develop Analytical and Logical skills.
4. To identify potential research problems.
5. To enhance competency to solve Mathematical Problems.
6. To acquire adequate theoretical knowledge to write dissertation
7. To get necessary training in using Mathematical Software
8. To acquire theoretical knowledge in various areas of Mathematics.

Sem.	Code	Title of the paper
I	18MMA101	Course-1: Professional Skills for Teaching-Learning
	18MMA102	Course-2: Research Methodology (OOC)
	18MMA103	Course-3: Algebra and Analysis
	18MMA104A	Course-4: Advanced Numerical Analysis
	18MMA104B	Course-4: Fundamentals of Domination in Graphs
	18MMA104C	Course-4: Product Graphs
	18MMA104D	Course-4: Labelling of Graphs
	18MMA104E	Course-4: Homological Algebra and Semigroups
	18MMA104F	Course-4: Stochastic Models in Queueing Theory
	18MMA104G	Course-4: Harmonic Analysis
	18MMA104H	Course-4: Advanced Fluid Dynamics
	18MMA104I	Course-4: Non-linear Differential Equations
	18MMA104J	Course-4: Fuzzy Automata Theory
	18MMA104K	Course-4: Cryptography
	18MMA104L	Course-4: Topology of Metric Spaces & Fixed Point Theory
	18MMA104M	Course-4: Wavelets, Fuzzy Automata and Chaotic Systems
	18MMA104N	Course-4: Fuzzy Mathematics and its Applications
	18MMA104O	Course-4: Linear Algebra and its Applications
II	18MMA205	Course-5: Dissertation

18MMA101

Paper-I

PROFESSIONAL SKILLS FOR TEACHING-LEARNING

Course Outcomes:

1. To empower scholars with soft skills.
2. To introduce the teaching and dynamics of teaching – learning
3. To facilitate e- learning/ e-teaching with the ICT tools.
4. To prepare scholars with material resources for class room teaching
5. To acquire basic knowledge in Latex.
6. To expose students to problem solving techniques in Real and Complex analysis .

Unit-I: Soft Skills

a. Introduction to Soft Skills, Soft Skills Vs Hard Skills, types of Soft Skills
b. Communication skills– Basics in communication, structure of written and oral sentences, Verbal, non-verbal, body language, JOHARI Window, Intrapersonal and Interpersonal Communications, Activities in Effective Communication
c. Behavioral Skills– Leadership skills, Time Management, Creativity and Lateral thinking
d. Interview Skills- Resume Writing, Different types of interviews, Etiquettes in interviews, Mock interviews
e. Team Building and Group Discussion– Progressive stages of Team Building, Parameters of GD (special reference to attending, listening, responding skills), Mock Group GDs

Unit II: Techniques and Dynamics of Teaching- Learning

a. Emerging trends in Educational Psychology– Meaning, Scope and Methods
b. Learning– Different Theories of learning, Approaches to learning(Classical Conditioning- Ivan Pavlov; Operant conditioning- B.F.Skinner); kinds of learning, factors affecting learning
c. Motivation: Intrinsic and extrinsic motivation, Development of memory and intelligence.

Unit III: Mathematical software for e-Learning and e-Teaching

Basics of MATLAB, input–output, General commands, Matrices and Vectors- Matrix and Array operations- inline functions- Using Built –in Functions- Plotting simple graphs-Programming in MATLAB: Scripts and

Functions- Script files – Functions files- Linear Algebra – Curve Fitting and interpolation – Data analysis and Statistics- Numerical integration- Ordinary differential equations – Nonlinear Algebraic Equations.

Unit IV: Material Resources for Class Room Teaching

Basics of a LaTeX file, Command names and arguments, Environments, Declarations, Lengths, Special Characters, Fragile commands, Documentclass, Page style, Parts of the document, Table of contents, Changing font, Lists, Theorem-like declarations, Tables, Footnotes and marginal notes, Mathematical Formulas, Mathematical environments, Main elements of Math mode, Mathematical symbols, Additional elements, Fine-tuning Mathematics, Floating tables and figures.

Unit V: : Problems in Real and Complex Analysis

Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle,

Books for Study:

Unit I

1. JASS (2013), Winners in the Making - Introduction to Soft Skills, St .Joseph's College, Trichy.
2. Murphy, Raymond. (1998). Essential English Grammar. 2nd ed., Cambridge University Press.
3. Trishna (2004) Knowledge System How to do well in GDs and Interviews. Reprographic and Printing services, Secunderabad.

Unit II

1. Covey, Stephen. (2004),7 Habits of Highly effective people, Free Press.
2. Driscoll, M. P. (2005),Psychology of Learning for Instruction, Pearson HigherEd. Gardner, Howard (1983; 1993) Frames of Mind: The theory of multiple intelligences, New York: Basic Books

Unit III

1. Rudra Pratap. (2010), Getting Started with MATLAB 7- A Quick introduction for Scientists and Engineers, Oxford University Press.

Unit IV

1. H. Kopka and P.W. Daly, (2003), A Guide to LaTeX,Addison-Wesley [Sections 1.5,2.1-2.6,3.1-3.4,4.1,4.3,4.5,4.10,5.1-5.5and 6.6]

Unit V

1. Tom M Apostol, Mathematical Analysis, Addison-Wesley Publishing Company, London, 1974.
2. S. Ponnusamy, Foundations of Complex Analysis, Second Edition, Narosa Publishing House, India, 2005

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18MMA101	Title of the Paper PROFESSIONAL SKILLS FOR TEACHING-LEARNING									Hours 5	Credits 2
Course Outcomes (COs)	Programme Outcomes (POs)				Programme Specific Outcomes (PSOs)							Mean Score of COs
	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
CO1	4	4	4	4	4	3	3	4	3	3	3	4	3.58
CO2	4	4	3	3	5	4	3	3	3	2	3	3	3.33
CO3	4	2	4	3	4	3	5	3	3	2	2	4	3.25
CO4	4	4	4	4	3	3	5	3	4	3	3	2	3.50
CO5	4	4	4	3	4	4	4	4	3	4	3	3	3.66
CO6	3	3	4	3	4	3	3	4	3	3	3	3	3.25
Overall Mean Score for COs													3.43

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

18MMA102

Paper-II
RESEARCH METHODOLOGY

Course Outcomes:

1. To empower scholars with Research Methodology.
2. To introduce the history of modern Mathematics.
3. To enhance problem solving skills in differential equations.
4. To prepare scholars with domination of Graphs
5. To acquire basic knowledge in metric spaces.
6. To give an introduction to important topological concepts.

Unit I: Research Methodology

Research – Research methods and methodology –Types of Research – Mode of approach– Art of writing a Research paper and thesis - Rise of Abstract Algebra– Aspects of Twentieth Century

(Text Book 1: pp 1- 48, Text Book 2: chapters 16, 17) http://www.sjctni.edu/Department/MA/OOC/unit1.jsp

Unit II: Problems in Differential Equations

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs

Unit III: Domination of Graphs

Domination number of Graph –The Independent Domination number of a Graph –Other Domination parameters.

(Text Book 4: Chapter 10, Sections 10.1, 10.2, 10.3) http://www.sjctni.edu/Department/MA/OOC/unit3.jsp

Unit IV: Metric Spaces

Complete Metric Spaces –Compactness in Metric Spaces –Pointwise Compact Convergence. (Text Book 5: Chapter 7 Sections 43, 45 & 46) http://www.sjctni.edu/Department/MA/OOC/unit4.jsp

Unit V: Homotopy

Homotopy of Paths –The Fundamental Group –Covering Spaces. (Text Book 5: Chapter 9 Sections 51, 52 & 53) http://www.sjctni.edu/Department/MA/OOC/unit5.jsp

Books for Study:

1. Research Methodology by S Rajasekar, P Philominathan and V Chinnathambi, e-material at http://arxiv.org/pdf/physics/0601009.pdf.
2. A History of Mathematics by Boyer B.Carl
3. Graphs and Digraphs, Fourth Edition - G.Chartrand and Lesniak, S.Chapman & Hall/CRC. 3rd edition (August 1, 1996)
4. Topology by James R.Munkres-Prentice Hall of India. (Second Edition),2002.

Reference Books:

1. General Topology by James Dugundji, Allyn and Bacon , Boston,1996.
2. History of Modern Mathematics by David Eugene Smith, Mathematical Monographs, Dover Books on Mathematics,1906.
3. Differential Equations with Applications and Historical Notes by George Simmons, Indian Edition
4. Introduction to Partial Differential equation by K. Sankara Rao, Third Edition, Eastern Economy edition

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Code	Title of the Paper											Hours	Credits
I	18MMA102	RESEARCH METHODOLOGY (OOC)												
Course Outcomes (COs)	Programme Outcomes (POs)				Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	3	4	3	2	4	4	3	4	3	4	4	4	3.5	
CO2	3	3	4	4	4	4	3	3	3	4	4	4	3.5	
CO3	3	3	2	3	4	4	3	3	4	4	4	3	3.3	
CO4	3	4	2	3	3	4	3	4	4	4	4	4	3.5	
CO5	3	3	4	2	4	3	4	4	4	4	4	4	3.5	
CO6	3	4	4	4	3	3	3	4	4	3	3	3	3.4	
									Overall Mean Score for COs				**3.4**	

Result: The Score for this Course is 3.4 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	**Mean Overall Score for COs** = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

18MMA103

Paper-III
ALGEBRA AND ANALYSIS

Course Outcomes:

1. To empower scholars with knowledge of pure mathematics.
2. To introduce the algebraic structure through modules.
3. To acquaint with advance concepts in algebra
4. To understand Borel measures.
5. To enhance problem solving skills in algebra.
6. To understand the techniques in algebra.

Unit-I: Modules

Modules homomorphism and exact sequence–Projective and injective–Modules homomorphism and duality. (Chapter 4.1, 4.3, 4.4, Text Book-1)

Unit-II: Commutative Rings and Modules

Chain conditions – Prime and primary ideals – Primary decomposition – Noetherian Rings and modules (Chapter 8.1, 8.2, 8.3, 8.4, Text Book – 1)

Unit III: Positive Borel Measures

Vector spaces – Topological preliminaries – Urysohn's Lemma–The Riesz representation theorem. (Chapter 2, Text Book -2, Sections 2.1-2.14).

Unit-IV: Problems in Algebra

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, Field extensions, Galois theory. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms

Unit V: Banach Algebras

Banach algebras – Spectrum of an element in Banach algebra – Spectral radius formula – Quotient algebras–applications.
(Chapter 18, Text Book-2)

Books for Study:

1. Algebra by Thomas W Hungerford, Springer Verlog Indian reprint 2004.

2. Real and Complex Analysis byWalter Rudin, Tata McGraw Hill (II Edn) 1996.

Reference Books:

1. Abstract Algebra by David.S.Dummit and Richard.M.Foote, 3rd Edition,Wiley Student Edition
2. Linear Algebra by Stephen H. Freidberg, Arnold J. Insel, Lawrence E. Spence, Fourth Edition, Pearson

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester I	Code 18MMA103				Title of the Paper ALGEBRA AND ANALYSIS								Hours	Credits
Course Outcomes (COs)	Programme Outcomes (POs)				Programme Specific Outcomes (PSOs)								Mean Score of COs	
	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8		
CO1	4	3	4	4	4	4	2	3	4	4	3	3	3.50	
CO2	3	4	3	2	4	3	4	3	4	4	2	3	3.25	
CO3	3	4	4	4	4	4	3	4	4	3	2	4	3.58	
CO4	4	4	3	4	5	3	4	4	5	3	2	4	3.75	
CO5	4	3	3	3	4	4	4	3	4	4	2	5	3.58	
CO6	3	3	4	4	3	3	4	3	3	3	2	4	3.25	
Overall Mean Score for COs													3.38	

Result: The Score for this Course is 3.3 (High Relationship)

Note:

Mapping	1-20%	21-40%	41-60%	61-80%	81-100%
Scale	1	2	3	4	5
Relation	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0
Quality	Very poor	Poor	Moderate	High	Very High

Values Scaling:

$$\text{Mean Score of COs} = \frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}} \qquad \text{Mean Overall Score for COs} = \frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$$

18MMA104A

Paper-IV
ADVANCED NUMERICAL ANALYSIS

Course Outcomes

1. Basic Knowledge of numerical methods
2. Approximation methods.
3. Linear and nonlinear approximation
4. Understanding polynomial equations
5. Techniques in numerical analysis
6. Initial and boundary value problems

Unit-I: Transcental and Polynomial Equations

Iteration method based on second degree equation – Rate of convergence – iterative methods – Methods for finding complex roots – iterative methods: Birge-Vieta method, Bairtow's method, Gracffe's root squaring method.

Unit-II: System of Algebraic Linear Equations

Direct methods – Gauss Jotdan Elimination Method - Triangularization method – Cholesky method – Partition method. Error Analysis – iteration methods : Jacobi iteration method – Gauss - seidal iteration method - SOR method, Jacobi's method for symmetric matrices – power method – Inverse power method.

Unit-III: Interpolation and Approximation

Hermite interpolation – Piecewise and spline interpolation – Approximation – Least square Approximation.

Unit-IV: Differentiation And Integration

Numerical differentiation – Numerical Integration – Methods based on interpolation.

Unit-V: Ordinary Differential Equations

Multi – step method – predictor – Corrector method – Boundary value problem – initial value methods – shooting method – Finite Difference method.

Text Book

M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for scientific and Engineering Computation, III Edn, Wiley Eastern Ltd., 1993.

Unit I - Chapter 2 – 2.4 to 2.8
Unit II - Chapter 3 – 3.2 to 3.5

Unit III - Chapter 4 – 4.4 – 4.6, 4.8 to 4.9
Unit IV - Chapter 2 – 2.4 to 2.8
Unit V - Chapter 6 – 6.4, 6.5, 6.8, 6.9, 6.10

References:

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

18MMA104B

Paper-IV

FUNDAMENTALS OF DOMINATION IN GRAPHS

Course Outcomes

1. Basic Knowledge of dominations
2. To learn local domination
3. To learn global domination
4. Understand Product graphs
5. To learn vizing conjecture
6. Applications of domination

Unit-I: Bounds in terms of degree

Bounds in terms of order and size-Bounds in terms of degree, diameter, and girth.

Unit-II: Bounds in terms of covering

Bounds in terms of independence and covering-Product graphs and Vizing's conjecture-Grid graphs.

Unit-III: Varieties of domination

Varieties of domination-Multiple dominations-Parity restrictions.

Unit-IV: Location of dominating sets

Locating domination-Distance domination.

Unit-V: Global domination

Strong and weak domination-Global and factor domination.

Book for Study:

1. Teresa W Haynes, Stephen T Hedetniemi, Peter J Slater, Marceal Dekker, *Fundamental of Domination in Graphs*, 1998., Marcel Dekker inc., 270-Madison Avenue, Newyork. (Sections: 2.3 to 2.6, 7.1 to 7.6.)

Reference Books:

1. Walikar H.B., Acharya B.D. and Sampathkumar E.-*Recent developments in the theory of domination in graphs: - MRI lecturenotes in Maths,* volume 1, 1979, Mahta Research Institute, Allahabad.
2. Teresa W. Haynes, Stephen T. Hedetniemi, and Peter. J. Slater. *Domination in graphs Advanced Topics* 1998, Marcel Dekker Inc., 270-Madison Avenue, New York.

18MMA104C

Paper-IV

PRODUCT GRAPHS

Course Outcomes

1. Theory of Product graphs
2. Understanding strong products
3. Understanding Cartesian products
4. Theory of automorphisms and invariants
5. Understanding direct products
6. Understanding Lexicographic products

Unit-I: Basic concepts

Graphs-Automorphisms and invariants-Hyper cubes and isometric sub graphs.

Unit-II: The Cartesian product

Prime factor decomposition-Automorphisms.

Unit-III: Strong products

Strong products and retracts-Direct products in G and $G_{o.}$

Unit-IV: Algebraic Structures

Basic algebraic properties of Lexicographic products.

Unit-V: Automorphisms

Automorphism in Lexicographic products.

Book for Study

1. Wilfred Imrich and Sandi Klavzar. Product graphs Structure and recognition, John Wiley & Sons Inc., New York, 2000
   (Sections 1.1 to 1.4, 4.1, 4.2, 5.1, 5.3, 6.1 and 6.3)

18MMA104D

Paper-IV
LABELLING OF GRAPHS

Course Outcomes

1. Basic Knowledge of Labelling
2. Understanding different types of labeling
3. Concepts of Edge Magic Labelling
4. Applications of Labelling
5. To learn Magic squares and anti magic squares
6. Understanding Theory of Cycles and Super EAT Labelling

Unit-I: Preliminaries

Magic Squares-Antimagic Squares-Magic Labeling-Antimagic Labeling.

Unit-II: Edge-Antimagic Labeling

Edge-antimagic vertex Labeling-Edge-antimagic total Labeling.

EAT Labeling of Cycles and Paths– Cycles-Paths.

Unit-III: Super Edge-Antimagic Labeling

Superedge-antimagic vertex labeling– Superedge-antimagic total labeling.

Unit-IV: Super EAT Labeling of Cycles and Cycles with Chord

Friendship graphs-Fans-Wheels.

Super EAT Labeling of Complete Graphs-Complete bipartite graphs-Complete Graphs.

Unit-V: Super EAT Labeling of Trees

Stars– Paths-Path like Trees -Caterpillars

Book for Study

1. Martin Baca and Mirka Miller,Super Edge-Antimagic Graphs, Universal-Publishers, 2008.
   Chapters: 2, 3, 4,5, 7, 9, 10.

18MMA104E

Paper-IV
HOMOLOGICAL ALGEBRA AND SEMI-GROUPS

Course Outcomes

1. Understanding theory of modules
2. To learn Projective modules
3. To learn injective modules
4. Understanding regular semi groups
5. Understanding inverse semi groups
6. Understanding concepts of semi lattices

Unit-I: Modules

Modules, Free modules, Exact sequences, Semi exact sequences, Tensor Products.

Unit-II: Modules of Homomorphisms

Modules of Homomorphisms. Projective Modules Injective modules-Categories and Functors-Notion of Category and functors and examples

(Treatment as in " Introduction to Homological Algebra by S. T.Hu.)

Chapter I and Chapter II Pages 24-100

Unit-III: Semigroup

Semigroup. Basic definitions, Semigroup of relations on a set of Congruences. Factor groupoids and homomorphisms-Units and Maximal subgroups.

UNIT-IV: Bands and semilattices

Bands and semilattices. regular semi groups, Inverse semi groups. Embedding semigroups in groups Free semi groups and generating relations.

UNIT-V: Green's relations

Green's relations. D-structre of the full transformation semi group Tx on a set x. Regular D-classes. Simple semigroups. Principal factors of a semigroup

(Treatment as in "The Algebraic theory of Semigroups" Vol I by A.H.Clifford and G.B. Preston Chapter I and II pages 1 –75)

Book for Study:

1. Northcotl, D. G., An introduction to Homological Algebra.Cambridge University Press, 1960.

18MMA104F

Paper-IV

STOCHASTIC MODELS IN QUEUEING THEORY

Course Outcomes

1. Basic knowledge of queueing theory
2. Understanding Birth Death Process
3. Understanding different stochastic models
4. Applications to real life problems
5. Study Waiting time distribution
6. To learn queueing in general service

Unit-I: M/M Models

Steady state solution for M/M/1 model-Measures of effectiveness-Waiting Time distributions-Little's formula-Finite system capacity-Queues with truncation (M/M/1/K) – Transient behaviour-Busy period analysis. (Sec 3.1 to 3.4).

Unit-II: Birth-Death Processes

Birth-Death Processes-Queues with parallel channels (M/M/C)-Queues with parallel channels and Truncation (M/M/C/K) - Erlang's formula (M/M/C/C). (Sec 3.1 to 3.4).

Unit-III: Queues with Unlimited Service

Queues with Unlimited Service (M/M/¥)-Steady state results-Transient analysis - Finite source Queues-State dependent Service - Queues with impatience-M/M/1 Balking - M/M1 Reneging.
(Sec 3.5 to 3.8).

Unit-IV: Bulk Input

Bulk Input (M^x/M/1)-Bulk Service (M/M^y/1) Erlangian Models (M/E_k/1 and E_k/M/1).
(Sec 4.1 to 4.3.2).

Unit-V: General Service

Single Server Queues with Poisson Input and General Service (M/G/1)-Measures of effectiveness-Steady system size Probabilities-Special Cases (M/E_k/1 and M/D/1)
(Sec 5.1.1 to 5.1.5).

Book for Study:

1. Donald Gross, Carl M. Harris, Fundamentals of Queueing Theory, John Wiley & Sons. New York, 1974

18MMA104G

Paper-IV

HARMONIC ANALYSIS

Course Outcomes

1. Understanding Fourier series
2. Understanding Fourier integrals
3. Applications of Harmonic Analysis
4. Understanding discrete group
5. Understanding compact group
6. Consequences of Minkowskiis theorem

Unit-I: Fourier Series & Integrals

Definition and easy results-The Fourier transform-Convolution, approximate identities, Fejer's theorem-Unicity theorem, Parseval relation; Fourier Stieltjes Coe-The Classical Rernals (Chaper 1)

Unit-II: Fourier series and Integrals

Summability: Metric Theorems-Pointwise summability-Positive definite sequences: Herglotz theorem-The inequality of Hausdorff and Young-Measures with bounded powers; endomorphisms (Chapter1)

Unit-III: The Fourier Integral

Introduction-Kernels of R-The Plancherel theorem-Another convergence theorem; the Poisson summation formula-Bochner's theorem-The continuity theorem. (Chaper 2)

Unit-IV: Discrete and Compact groups

Characters of discrete groups-Characters of compact group-Bochner's theorem (Chapter 3; Sec 3.1, 3.2, 3.3)

Unit-V: Measure

Examples-Minkowski's theorem-Measure on infinite product spaces-continuity of seminorms. (Chapter 3; Sec 3.4, 3.5, 3.6, 3.7)

Book for Study:

1. Henry Helson, Harmonic Analysis,Addison-Wesley Pub (Sd) (May 1983)

18MMA104H

Paper-IV
ADVANCED FLUID DYNAMICS

Course Outcomes

1. Understanding advanced concepts in fluid dynamics
2. Understanding motion of a sphere
3. Understanding concentric sphere
4. Understanding Wave motion
5. Understanding Newtonian motion
6. Applications of Fluid dynamics

Unit-1: Motion of a Sphere

Motion of a Sphere through an infinite massAof a liquid at rest at infinity - Liquid streaming past a fixed sphere -Equations of motion of a Sphere - Sphere projected in a liquid under gravity- Pressure distribution on a Sphere.
[Chapter 8, Articles 8.1 to 8.7, pp. 350 to 371]

Unit-II: Concentric Spheres

Concentric Spheres - Problem of Initial motion - Three dimensional sources, sinks and doublets - Complex Potential due to a 3D doublet -Image of a 3D source w.r.to a plane-Image of a 3D doublet w.r.to a plane- Image of a 3D source w.r.to a Sphere- image of a doublet in front of a Sphere.
[Chapter 8 Articles 8.9 to 8.17 pp. 371 to 396]

Unit-III: Wave motion

General expression of a wave motion -Mathematical representation of wave motion - standing or Stationary waves -Types of liquid waves-Surface waves-Energy of Progress waves - Energy of Stationary waves- Progressive waves reduced to a case of Steady motion - Waves at the interface of two liquids.
[Chapter 10 Articies 10.1 to 10.10 pp. 508 to 524]

Unit-IV: Newtonian

Newton's law of viscosity- Newtonian and Non-Newtonian fluids- Body and Surface forces-Stress vector - State of stress at a point-Plane Stress, Principal stresses and Principal directions. [Chapter 11...Articles 11.1 to 11.10 pp. 553 to 572]

Unit-V: Nature of strain

Transformation of the rates of strain components Relation between stress and rates of strain-Stoke's law of viscosity.
[Chapter II...Articles 11.12 to 11.14 pp. 582 to 594]

Book for Study:

1. Raisinghania, M.D., Fluid Dynamics,2003, S.Chand &co

Reference Book:

1. Frank Charlton , Text Book of Fluid Dynamics , 2000, CBS Publishers and Distributors

18MMA104I

Paper-IV
NON-LINEAR DIFFERENTIAL EQUATIONS

Course Outcomes

1. Basic concepts of differential equation
2. Understanding Integral Manifolds
3. Application of nonlinear differential equation
4. Understanding Central manifolds
5. To learn Lorenz Equations
6. Understanding fractal sets

Unit-1: Integral Manifolds

Groanwall's inequality - phase space - critical points - periodic solutions - First integrals and integral manifolds - Liouville's theorem.

Unit-II: Linear System

Two, three dimensional linear systems - critical points of nonlinear equations - The Poincare-Bendixson theorem and its applications - periodic solutions in R^n.

Unit-III: Stability Theory

Stability - stability of equilibrium solutions - stability of periodicsolutions - linearisation - asymptotic stability - instability.

Unit-IV: Centre Manifolds

Bifurcation - averaging and normalisation - centre manifolds-bifurcation of equilibrium solutions - Hopf bifurcation.

Unit-V: Chaos

Chaos - The Lorenz equations - one dimensional chaos: the quadratic map, the tent map - Fractal sets and its dynamical characterisations — Lyapunov exponents.

Book for Study

1. Ferdinand Verhulst, Nonlinear Differential Equations and Dynamical Systems, 2nd Edition, Springer, 1996. (Chapters: 1-5, 7, 13 and 14.)

18MMA104J

Paper-IV
FUZZY AUTOMATA THEORY

Course Outcomes

1. Basic concepts of automata theory
2. Understanding fuzzy theory in automata
3. Applications of automata
4. Understanding fuzzy grammar and context free grammar
5. Understanding fuzzy languages
6. Applications of Pumping lemma

Unit-1:

Finite Automata

Finite State System - Basic Definitions - Non-Deterministic Finite Automata- Finite Automata with Î-moves - Regular Expressions.

Chapter- 2 (Section: 2.1 to 2.5)

Unit-II:

Properties of Regular Sets

The Pumping Lemma for regular sets- Closure Properties of regular sets.

Chapter-3 (Section: 3.1, 3.2), Chapter- 4 (Section: 4.1, 4.2)

Unit-III:

Context Free Grammars

Motivation and Introduction-Context-Free Grammars - Derivation Trees- Implication of Context-Free Grammars - The Pumping Lemma for Context-Free Languages - Closure Properties of Context-Free Languages.

Chapter- 4 (Section: 4.3, 4.4), Chapter- 6 (Section: 6.1, 6.2)

Unit-IV:

Fuzzy Set Theory

Definitions - Basic Operations on Fuzzy Sets - The Extension Principle Membership functions and Fuzzification.

Chapter- 2 (Section: 2.2 to 2.5)

Unit-V:

Fuzzy Grammar and Fuzzy Automata

Fuzzy Languages - Fuzzy Grammars - Fractionally Fuzzy Grammars - Fuzzy Automata. Chapter- 8 (Section: 8.2 to 8.4, 8.10)

Books for Study:

For Unit I, II & III:

1. John. E. Hopcroft (J.E.H) & Jeffrey D. Ullman (J.D.U), Introduction to Automata Theory, Languages and Computation, Narosa Publishing House,1997.

For Unit IV & V:

2. Sankar K. Pal and D Wijesh K. Dutta Majumder, Fuzzy Mathematical Approach to Pattern Recognition. Wiley Eastern Ltd, 1987.

18MMA104K

Paper-IV

CRYPTOGRAPHY

Course Outcomes

1. Basic concepts of cryptography
2. Understanding concepts of Public key
3. Understanding concepts of symmetric key
4. Understanding RSA system
5. To learn discrete algorithm
6. Applications of cryptography

Unit-1: Symmetric key encryption

Symmetric key encryption-Stream ciphers-Block Ciphers - DES-Modes of operation.

Unit-II: Public-key cryptography

Modular arithmetic-Discrete key log function-RSA system.

Unit-III: Operations in RSA

Digital signature-Hash functions-Merkle's method-Probabilistic signatures

Unit-IV: Discrete logarithm

Elgamal's encryption-Digital signature algorithm - Robin's encryption

Unit-V: Protocols

Kerberos-Diffie-Hellman key agreement-Fiat-Shamir identification scheme-Zero knowledge

Book for Study:

1. Hans Delfs and Hellmut Knebl , Introduction To Cryptography, 2003,Springer Chapter 2 : 2.1, 2.2, Chapter 3, Chapter 4 : 4.1, 4.2.1 to 4.2.3

Reference Book:

1. Koblitz, A course in Number Theory and Cryptography, 1994, Springer-Verlag.

18MMA104L

Paper-IV

TOPOLOGY OF METRIC SPACES AND FIXED-POINT THEORY

1. Basic Knowledge of metric spaces
2. To learn various types of metric spaces
3. Understanding fixed point theory
4. Concepts of normal structure and nonexpansive mapping
5. Understanding Hyperconvex spaces
6. To learn Banach Lattices

Unit-1: Metric Contraction Principles

Banach's contraction Principles-Extensions of Banach's Principle - the caristi - Ekeland Principle - Equivalent of the caristi - Ekeland Principle - Set valued contractions - Generalised contractions. (Chapter 3: Sec : 3.1-3.6)

Unit-II: Hyper Convex Spaces

Hyper convexity-Properties of Hyper convex spaces-a fixed point theorem – intersection of hyper convex spaces-approximate fixed points-Isbell's hyper convex hull. (Chapter 4: Sec: 4.2-4.7)

Unit-III: Normal Structures in Metric Spaces

A fixed point theorem-structure of the fixed point set-uniform normal structure-uniform relative normal structure-Quasi normal structure-Stability and normal structure-ultra metric spaces-fixed point set structure-separable case. (Chapter 5: Sec : 5.1-5.8)

Unit-IV: Metric Fixed Point Theory

Contraction mapping-Basic theorems for nonexpansive mapping-A closer look at l_1-The Goebel-Karlovitz Lemma-Orthogonal Convexity (Chapter 8: Sec: 8.1-8.6)

Unit-V: Fixed Point Theory in Banach Lattices

Structure of the fixed point set-Asymptotically regular mapping-set valued mappings – Fixed point theory in Banach lattices. (Chapter 8: Sec : 8.7-8.10)

Book for Study:

1. An introduction to Metric spaces and fixed point theory - Mohamed A.Khasi and William A. Kirk, A. Wiley-Inter Science Publication Johnwiley and Sons Inc. First edition (March 6, 2001)

18MMA104M

Paper-IV

WAVELETS, FUZZY AUTOMATA AND CHAOTIC SYSTEMS

Course Outcomes

1. Understanding theory of wavelets
2. Basic ideas of chaotic systems
3. Concepts of disrete fourier transform
4. Concepts of fast fourier transform
5. Understanding finite state machines
6. Identifying chaotic behavior in real life situations

Unit-1: The Discrete Fourier Transform

Properties of Discrete Fourier Transform - Translation - Translation - invariant - The Fast Fourier Transform (Chapter II , Section 2.1, 2.2, 2.3).

Unit II: Wavelets on Z_N

Construction of wavelets on Z_N: First Stage - Construction of wavelets on Z_N: The Iteration step - Examples and Applications.
(Chapter III, Section 3.1, 3.2, 3.3)

Unit III: Fuzzy Automata

Fuzzy subsets – finite state machines – finite state automata – languages and grammar – nondeterministic finite state automata – relations between languages and automata - Fuzzy languages – types of fuzzy grammars.
(Sections 1.4, 1.6-1.10, 4.1, 4.2)

Unit IV: Fuzzy Grammar

Fuzzy context – free grammars – fuzzy context – free Max-product grammars - Fuzzy finite state machines – Homomorphisms – Submachines of a fuzzy finite state machine – fuzzy recognizers and its languages.
(Sections 4.3,4.4, 6.1 - 6.3,6.7, Pages 337,338 of section 7.2.)

Unit V: Chaotic Systems

Periodic orbits - Denseness of orbits - Invariant measure - Lyapunov number - Chaos in conservative and dissipative systems - Attractor and Poincare section. (Chapter 2, Section 2.2, 2.6-2.8, Chapter 4, Section 4.1,4.2)

Books for Study

1. For units I and II : An Introduction to Wavelets through Linear Algebra-Michael W. Frazier, Springer,1999.

2. For units III and IV: Fuzzy Automata and Languages Theory and Applications. John.N.Mordeson and Davender.S.Malik, CRC Press Company, 2002.
3. For unit V: Introduction to Chaos-H. Nagashima and Y. Baba, Overseas Press, New Delhi, 2005

18MMA104N

Paper-IV

FUZZY MATHEMATICS AND ITS APPLICATIONS

Course Outcomes

1. Basics of fuzzy sets
2. Understanding fuzzy relations
3. Understanding fuzzy arithmetic
4. Concept of Fuzzy decision making
5. Understanding fuzzy clustering
6. Applications of fuzzy theory

Unit-1: Basics of Fuzzy Sets

Fuzzy sets - Introduction, Basic types and Basic concepts, Additional properties of a-cuts, Representation of fuzzy sets, Extension principles. Type of operators on fuzzy sets and fuzzy complements, Fuzzy intersection and fuzzy unions, Combination of operations.

Unit-II Fuzzy Arithmetic

Fuzzy numbers and arithmetic operations on intervals, Arithmetic operations on fuzzy numbers, Fuzzy equations.

Unit-III Fuzzy Relations

Binary fuzzy relations, Binary relation on a single set, Fuzzy equivalence relations, Problem partitioning, solution method, Fuzzy relation equation based on sup-i compositions, Fuzzy relation equation based on inf-ω_i compositions.

Unit-IV Fuzzy Decision Making

Fuzzy simple additive weighing methods - Dubois and Prade's Approach, Analytical Heirarchical process methods, Saaty's AHP approach.Max-min methods - Bellman and Zadeh's approach, Yager's approach.

Unit-V Fuzzy Clustering

Classifications by equivalence relations-Crisp relations, Fuzzy relations, Cluster Analysis, Cluster Validity,c-means Clustering - Hard C-Means (HCM), Fuzzy C-Means (FCM)

Text Books:

George J.Klir, Bo Yuan, Fuzzy Sets and Fuzzy logic-Theory and Applications, Prentice Hall India, New Delhi, 1997.

Reference Books:

1. H.J Zimmermann, Fuzzy sets, Decision making and expert systems, Kluwer, Bosten, 1987.
2. S.J. Chen and C.L.Hwang, Fuzzy Multiple Attributes Decision Making, Springer verlag, Berlin Heidelberg, 1992.

18MMA104O

Paper-IV

LINEAR ALGEBRA AND ITS APPLICATIONS

Unit-I

Elementary Canonical Forms and The Rational and Jordan Forms

Introduction, Characteristic Values, Annihilating Polynomials, Invariant Subspaces, Simultaneous Triangulation; Simultaneous Diagonalisation, Direct-Sum Decompositions, Invariant Direct Sums, The Primary Decomposition Theorem.

Cyclic Subspaces and Annihilators, Cyclic Decompositions and the Rational Form, The Jordan Form, Computation of Invariant Factors, Summary; Semi-Simple Operators.

Unit-II

Inner Product Spaces and Operators on Inner Product Spaces

Inner products, Inner Product Spaces, Linear Functionals and Adjoints, Unitary Operators, Normal Operators.

Introduction, Forms on Inner Product Spaces, Positive Forms, More on Forms, Spectral Theory, Further Properties of Normal Operators.

Unit-III

Bilinear Forms

Bilinear Forms, Symmetric Bilinear Forms, Skew-Symmetric Bilinear Forms, Groups Preserving Bilinear Forms.

Unit-IV

Singular Values and Their Decomposition

Singular Value Decomposition, Extremal Representations, Majorization, Principal Components, Canonical Correlations, Volume of a matrix.

Unit-V

Block Designs, Optimality, Rank Additivity

Reduced Normal equations, The *C*-Matrix, E-, A-, and D-Optimality.

Preliminaries, Characterization of Rank Additivity, General Linear Model, The Star Order.

Text Books:

1. Kenneth Hoffman and Ray Kunze , Linear Algebra, PHI Learning Private Limited, New Delhi, 2009.

Reference Books:

1. R.B. Bapat, Linear Algebra and Linear Models, Springer-Verlag New York, Inc., and Hindustan Agency, 2000.
2. Stephen H. Friedberg, Arnold J. Insel and Lawrence E. Spence, Linear Algebra, Prentice Hall, Englewood Cliffs, New Jersey, 1989.

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