M.PHIL. SYLLABUS – 2015

MATHEMATICS

DEPARTMENT OF MATHEMATICS
ST. JOSEPH'S COLLEGE (Autonomous)
Accredited at A Grade (3rd cycle) by NAAC
College with Potential for Excellence by UGC
Tiruchirappalli – 620 002

GUIDELINES FOR FULL TIME M.PHIL.

1. **Duration:** The programme runs for one year consisting 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	3	C5	Dissertation (Topic selected should be relevant to the topic of the Guide Paper)	8
C2	Research Methodology	4			
C3	Core Course	5			
C4	Guide Paper	5			
	Total	17		Total	8

2. a) Each Course should contain 5 units, covering the subject requirements of the courses offered.

Marks for CIA and SE are in the ratio 40 : 60.

The CIA components are **Mid Semester Test (25), End Semester Test (25), Seminar (15), Objective Type Assignment Test (15)**. The total mark 80 will be converted into 40 marks. **The tests and Semester Examination are centrally conducted by COE for 3 hours.**

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

Scholar should acquire **a minimum of 20 marks from CIA to appear for SE.** The Scholar should acquire a minimum of 30 marks in Semester Examination. He / She will be declared to have passed in the various courses in Semester I, provided he/she secures not less than 50 marks on an aggregate (CIA+SE).

2. b) (i) In course C1 on **'Professional Skills for Teaching – Learning'** the first three units are common to all the Departments of the College. The Academic Council has granted permission to incorporate some modifications in the C1 Course by Physics, Computer Science and Mathematics Departments. The first three unit titles are **Soft Skills, E-teaching, E-learning, Elements of Technology of Teaching and Learning.** The remaining two units are department specific to make use of the above mentioned skills & techniques to teach the Core Course.

The C1 Course is (to be) designed to exploit 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 Industry. Thus only for the course (C1) the written component is 60% and Practical component is 40% both in CIA and SE.

b) (ii) **Evaluation for C1:**

Theory Component: For both CIA & 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 (30). The total 100 will be converted into 25 marks.

Practical Component: The last TWO units are department specific. There is no Mid and End Semester Tests. But the CIA for the same are assessed continuously by the teacher(s) concerned totaling 15 marks. For SE, the Practical evaluation is done by an external examiner.

c) Question papers for C1, C2 & C3 are set by External Examiners.

d) Question paper for C4 will be set and valued by the Research Advisor only.

e) 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.

3. Credits:

	Courses	**Title**		**Contact Hrs.**	**Library Hrs.**	**Total Hrs.**	**Cr**	**CIA Mk.**	**SE Mk.**	**Total Mk.**
SEMESTER – I	C1	Professional Skills for Teaching – Learning	T	3	2	5	2	25	35	60
			P	2	2	4	1	15	25	40
	C2	Research Methodology		5	4	9	4	40	60	100
	C3	Core Course		5	5	10	5	40	60	100
	C4	Guide Paper		5	5	10	5	40	60	100
	Total			**20**	**18**	**38**	**17**	**160**	**240**	**400**

		INTERNAL			**EXTERNAL**		
			Cr	**Mk**		**Cr**	**Mk**
SEMESTER – II	**C5 – DISSERTATION**	Seminar & Review of Related Literature	2	15	Dissertation Evaluation	6	75
		Mid Term Review Presentation	2	15	*Viva-voce*	2	25
		Dissertation Work	3	60			
		Viva-Voce	1	10			
Total			**8**	**100**		**8**	**100**

4. Question Pattern:

	Course	Mid & End Semester Tests and Semester Examinations		
Science	**C1**	Section A : Short Answers Section B : Either / Or – Essay Type	7/9 3	7 x 2 = 14 3 x 7 = 21
	C2	Section A : Short Answers Section B : Either / Or – Essay Type	10 5	10 x 2 = 20 5 x 8 = 40
	C3	Section A : Short Answers Section B : Either / Or – Essay Type	10 5	10 x 2 = 20 5 x 8 = 40
	C4	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
Arts	**Course**	**Mid & End Semester Tests and Semester Examinations**		
	C1	Section A : Short Answers Section B : Either / Or – Essay Type	7/9 3	7 x 2 = 14 3 x 7 = 21
	C2	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
	C3	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
	C4	Open Choice : Comprehensive Type	5/8	5 x 12 = 60

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 the Semester –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 for 90% as stated above to the COE in a sealed cover

5.3. All the M.Phil. Scholars (along with their Guides) have to submit at least one Research articles for publication, at the time of submitting the dissertation.

Departments (with the constituted Expert Committee) will scrutinize; select and recommend the best articles for a publication either in RETELL or in School-based Journals.

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. *Viva-Voce*

The external examiner who valued the Dissertation and the Research Adviser shall conduct the *Viva-Voce* for the candidate for a maximum of 100 marks. A Candidate shall be declared to have passed in *viva-voce* if he/she secures not less than 50% of the marks prescribed for Dissertation and 50% of the marks in the aggregate of the marks secured in *viva-voce* and Dissertation valuation. A student can undertake dissertation in the second semester whether or not he/she has passed the first semester.

6. Classification of Successful Candidates

6.1. The candidates who pass the Semester– I and Semester – II examinations in their first attempt shall be classified as follows:

S. No.	Total Marks secured in Semester – I and Semester–II Examinations	Classification
1.	80% and above in the case of Science Subjects & 75% and above in the case of Arts and Social Science Subjects	I Class with Distinction
2.	60% to 79% in the case of Science Subjects & 60 % to 74% in the case of Arts and Social Science Subjects	I Class
3.	50% to 59% in all the subjects	II Class

Note: Mathematics, Statistics and Computer Science/Application shall be treated as Science Subjects

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 he guide concerned should be recorded in he 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 COURSE PATTERN – 2015

Sem	Code	Title of the Paper
I	15MMA101	Course – C1: Professional Skills for Teaching - Learning
	15MMA102	Course – C2: Research Methodolgy (OOC)
	15MMA103	Course – C3: Algebra and Analysis
	15MMA104A	Course – C4: Wavelets , Fuzzy Automata And Chaotic Systems
	15MMA104B	Course – C4: Fundamentals of Domination In Graphs
	15MMA104C	Course – C4: Product Graphs
	15MMA104D	Course – C4: Labeling of Graphs
	15MMA104E	Course – C4: Homological Algebra and Semigroups
	15MMA104F	Course – C4: Stochastic Models in Queueing Theory
	15MMA104G	Course – C4: Harmonic Analysis
	15MMA104H	Course – C4: Advanced Fluid Dynamics
	15MMA104I	Course – C4: Nonlinear Differential Equations
	15MMA104J	Course – C4: Fuzzy Automata Theory
	15MMA104K	Course – C4: Cryptography
	15MMA104L	Course – C4: Topology of Metric Spaces And Fixed Point Theory
	15MMA104M	Course – C4: Advanced Numerical Analysis
II	15MMA205	Course – C5: Dissertation

M Phil. MATHEMATICS - 2015

Sem I

15MMA101

Paper I: PROFESSIONAL SKILLS FOR TEACHING - LEARNING

Objectives:

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
4. To give an introduction to propositional and predicate calculi.

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: Logic

Propositions: Fully Parenthesized Propositions– Evaluation of constant propositions– Evaluation of propositions in a state– Precedence Rules for Operators– Tautologies.Reasoning using Equivalence Transformation:The Laws of Equivalence – The Rules of Substitution and Transitivity– A Formal System of Axioms and Inference Rules.A Natural Deduction System:Introduction to Deduction Proofs– Inference Rules– Proofs and Subproofs.

Books for Study:

Unit I

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

Unit II

Covey, Stephen. (2004),**7 Habits of Highly effective people**, Free Press.
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

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

Unit IV

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

David Gries, (1991), **The Science of Programming**, Narosa Publishing House, New Delhi. [Chapters 1,2,3]

Sem I
15MMA102

PAPER II: RESEARCH METHODOLGY (OOC)

Objectives:

1. To empower scholars with Research Methodology.
2. To introduce the history of modern Mathematics.
3. To understand the chaotic behavior with the help of MATLAB.
4. To prepare scholars with domination of Graphs
5. 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: Chaos

Three simple Chaotic systems Mechanical, Chemical oscillators, The Lorenz equation – Mappings Logistic, Henon maps– Fixed and periodic points of maps – Tents and Horse shoes. (Chapter XV, Section 15.1, 15.2 – 15.2.2)
http://www.sjctni.edu/Department/MA/OOC/unit2.jsp

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. **Differential Equations(Linear, Non-Linear, Ordinary, Partial)**.- A.C.King, J.Billingham, S.R.Oho Cambridge University Press (2003)
4. **Graphs and Digraphs**, Fourth Edition - G.Chartrand andLesniak, SChapman & Hall/CRC. 3rd edition (August 1, 1996)
5. **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.

SEM-I
15MMA103

PAPER-III: ALGEBRA AND ANALYSIS

Objectives:

1. To empower scholars with knowledge of pure mathematics.
2. To introduce the algebraic structure through modules.
3. To understand Borel measures in Real and Complex Fields.
4. To prepare scholars with L^p Spaces for the study of analysis.
4. To give an introduction to Banach 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: L^p Spaces

Convex functions and inequalities– The L^p Spaces –Approximation by continuous functions.
(Chapter 3, Text Book-2)

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**byThomas W Hungerford , Springer Verlog Indian reprint 2004.
2. **Real and Complex Analysis** byWalter Rudin, Tata McGraw Hill (II Edn) 1996.

Sem – I
15MMA104A

PAPER IV: WAVELETS, FUZZY AUTOMATA AND CHAOTIC SYSTEMS

Unit I: 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

Sem I

15MMA104B

PAPER – IV: FUNDAMENTALS OF DOMINATION IN GRAPHS

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:

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, Newyork.

Sem I

15MMA104C

PAPER – IV PRODUCT GRAPHS

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 Γ and $\Gamma_{o.}$

Unit – IV: Algebraic Structures

Basic algebraic properties of Lexicographic products.

Unit – V: Automorphisms

Automorphism in Lexicographic products.

Book for Study:

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)

Sem I

15MMA104D

PAPER – IV: LABELING OF GRAPHS

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:

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

Sem I

15MMA104E

PAPER – IV: HOMOLOGICAL ALGEBRA AND SEMIGROUPS

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:

NORTHCOTL D.G.,**An introduction to Homological Algebra.**Cambridge University Press, 1960

Sem I

15MMA104F

PAPER - IV : STOCHASTIC MODELS IN QUEUEING THEORY

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:

Donald Gross, Carl M. Harris, **Fundamentals of Queueing Theory,** John Wiley & Sons. Newyork., 1974

Sem I

15MMA104 G

PAPER – IV: HARMONIC ANALYSIS

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:

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

Sem I

15MMA104H

PAPER - IV: ADVANCED 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.
[Chapterl0 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 l1...Articles 11.12 tol1.14 pp. 582 to 594]

Book for Study:

RAISINGHANIA M.D., **Fluid Dynamics**,2003, S.Chand &co

Reference Book:

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

Sem I

15MMA104I

PAPER IV – NONLINEAR DIFFERENTIAL EQUATIONS

Unit – I: 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:

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

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PAPER IV-- FUZZY AUTOMATA THEORY

Unit – 1: Finite Automata

Finite State System - Basic Definitions - Non-Deterministic Finite Automata- Finite Automata with $\in$-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: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:SANKAR K.PAL AND DWIJESH K.DUTTA MAJUMDER, **Fuzzy Mathematical Approach to Pattern Recognition.** Wiley Eastern Ltd, 1987.

Sem I

15MMA104K

PAPER – IV: CRYPTOGRAPHY

Unit – I: 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:

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:

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

Sem I

15MMA104L

PAPER – IV: TOPOLOGY OF METRIC SPACES AND FIXED POINT THEORY

Unit – I: 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:

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)

Sem I

15MMA104M

PAPER – IV: ADVANCED NUMERICAL ANALYSIS

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 - Triangularizationmethod – 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.

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