**ESTD.1889**

# ST.THOMAS' COLLEGE
# (AUTONOMOUS)
# THRISSUR

*Affiliated to*

### UNIVERSITY OF CALICUT

### SYLLABUS FOR DEGREE OF

### MASTER OF SCIENCE (M.Sc.)

### IN

### MATHEMATICS

**(2015 onwards)**

## Semester I

| Course Code | Title of the Course | No. of Credits | Work Load Hrs. | Core/ Elective |
|---|---|---|---|---|
| MT1C01 | Algebra 1 | 4 | 5 | Core |
| MT1C02 | Linear Algebra | 4 | 5 | Core |
| MT1C03 | Real Analysis - I | 4 | 5 | Core |
| MT1C04 | ODE and Calculus of Variations | 4 | 5 | Core |
| MT1C05 | Discrete Mathematics | 4 | 5 | Core |

## Semester II

| Course Code | Title of the Course | No. of Credits | Work Load Hrs. | Core/ Elective |
|---|---|---|---|---|
| MT2C06 | Algebra II | 4 | 5 | Core |
| MT2C07 | Real Analysis II | 4 | 5 | Core |
| MT2C08 | Topology I | 4 | 5 | Core |
| MT2C09 | PDE and Integral Equations | 4 | 5 | Core |
| MT2C10 | Number Theory | 4 | 5 | Core |

## Semester III

| Course Code | Title of the Course | No. of Credits | Work Load Hrs. | Core/ Elective |
|---|---|---|---|---|
| MT3C11 | Complex Analysis | 4 | 5 | Core |
| MT3C12 | Functional Analysis I | 4 | 5 | Core |
| MT3C13 | Topology II | 4 | 5 | Core |
| MT3C14 | Linear Programming and its Applications | 4 | 5 | Core |
| | Project | | 5 | Core |

## Semester IV

| Course Code | Title of the Course | No. of Credits | Work Load Hrs. | Core/ Elective |
|---|---|---|---|---|
| MT4C15 | Functional Analysis II | 4 | 5 | Core |
| MT4C16 | Differential Geometry | 4 | 5 | Core |
| MT4E01 | Elective I | 4 | 5 | Elective |
| MT4E02 | Elective II | 4 | 5 | Elective |
| MT4C17 | Project | 5 | 5 | Core |
| MT4V01 | General Viva | 3 | | Core |

# EXAMINATION

There shall be University examination at the end of each semester. Project evaluation and Viva –Voce shall be conducted at the end of the programme only. Practical examination, Project evaluation and Viva-Voce shall be conducted by two examiners( one external and one internal)

## EVALUATION AND GRADING

The evaluation scheme for each course shall contain two parts; (a) internal evaluation and (b) external evaluation. 25% weightage shall be given to internal evaluation and the remaining 75% to external evaluation. Therefore the ratio and weightage between internal and external is 1:3.Both internal and external evaluation shall be carried out using Direct grading system.

| Component | Weightage |
|-----------|-----------|
| Assignment | 1 |
| Seminar | 1 |
| Attendance | 1 |
| 2 Test Papers | 1+1 |

## Attendance

| Percentage of Attendance | Grade |
|--------------------------|-------|
| 90 % and above | A |
| 85 - 90 | B |
| 80 - 85 | C |
| 75 - 80 | D |
| Below 75% | E |

To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal grade.

The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the CE.

External evaluation: The external Examination in theory courses is to be conducted by the University with question papers set by experts. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation. The external evaluation shall be done immediately after the examination.

## DIRECT GRADING SYSTEM

Direct Grading System based on a 5 – point scale is used to evaluate the performance (External and Internal Examination of students)

### DIRECTGRADINGSYSTEM

| Letter Grade | Performance | Grade Point | Grade Range |
|---|---|---|---|
| A | Excellent | 4 | 3.50 to 4.00 |
| B | Very good | 3 | 2.50 to 3.49 |
| C | Good | 2 | 1.50 to 2.49 |
| D | Average | 1 | 0.50 to 1.49 |
| E | Poor | 0 | 0.00 to 0.49 |

Each course is evaluated by assigning a letter grade (A,B,C,D or E) to that course by the method of direct grading. The internal (weightage =1) and external weightage =3) components of a course are separately graded and then combined to get the grade of the course after taking into account of their weightage

An aggregate of C-grade (when external and internal put together) is required in each course for a pass and also for awarding the degree.

A student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of semester, a student should pass all courses and score a minimum SGPA of 2.0. However, a student is permitted to move to the next semester irrespective of her/his SGPA.

For instance, if a student has registered for 'n' courses of credits C1,C2

.............,Cn in a semester and if she/he has scored credit points P1, P2.............,Pn respectively in these courses, then SGPA of the student in that semester is calculated using the formula.

$$SGPA = \frac{P_1 + P_2 + \cdots + P_n}{C_1 + \cdots + C_n}$$

$$CGPA = \frac{(SGPA)_1 S_1 + (SGPA)_2 S_2 + \cdots + (SGPA)_4 S_4}{S_1 + \cdots + S_4}$$

# DETAILED SYLLABI

## SEMESTER I

### MT1C01 : ALGEBRA - I

**No. of Credits : 4**
No.of hours of Lectures/week : 5

### TEXT : FRALEIGH, J.B. : A FIRST COURSE IN ABSTRACT ALGEBRA.
( Fifth edn.) Narosa (1999.)

### UNIT I

Plane Isometries (page 113), Direct products & finitely generated Abelian Groups, Binary Linear Codes, Factor Groups, Factor-Group Computations and Simple Groups, Series of groups.
[§§ 2.2(only Plane Isometries) 2.4, 2.5, 3.3, 3.4, 3.5]

### UNIT II

Group action on a set, Applications of G-set to counting, Isomorphism theorems: Proof of the Jordan-Holder Theorem (Omit Butterfly Lemma and Proof of the Schreier Theorem), Sylow theorems, Applications of the Sylow theory, Free Groups (Omit Another look at Free abelian groups).
[ §§ 3.6, 3.7, 4.1, 4.2, 4.3, 4.5]

### UNIT III

Group Presentations, Rings of polynomials, Factorization of polynomials over a field, Non commutative examples, Homomorphism and factor rings.
[ §§ 4.6, 5.5, 5.6, 5.7, 6.1]

### REFERENCES

1. I.N. Herstein : Topics in Algebra
   Wiley Eastern (Reprint)
2. N.H. McCoy and R.Thomas : Algebra.
   Allyn & Bacon Inc. (1977).
3. J. Rotman : The Theory of Groups
   Allyn & Bacon Inc. (1973)
4. Hall,Marshall : The Theory of Groups.
   Chelsea Pub. Co. NY. (1976)
5. Clark, Allan : Elements of Abstract Algebra
   Dover Publications (1984)
6. L.W. Shapiro : Introduction to Abstract Algebra
   McGraw Hill Book Co. NY (1975)

7.  N. Jacobson : Basic Algebra , Vol. I.
Hindustan Publishing Corporation (India),
Delhi 110 007 Reprint (1991)

8.  T.W. Hungerford : Algebra
Springer Verlag GTM 73 (1987) 4th Printing.

9.  D.M. Burton : A First Course in Rings and Ideals
Addison Wesley 1970

10. Mac Lane & Brikhoff : Algebra
Macmillian

11. Joseph A. Gallian : Contemporary Abstract Algebra (4th Edition)
Narosa 1999

# MT1C02 : LINEAR ALGEBRA

**No. of Credits : 4**

**No. of hours of Lectures/week : 5**

TEXTS : 1. **HOFFMAN, K., and KUNZE, R., LINEAR ALGEBRA,** (2nd Edn.) , Printice-Hall of India, 1991.

## UNIT I

Vector Spaces & Linear Transformations
[Chapter 2 Sections 2.1 – 2.4; Chapter 3 Sections 3.1 to 3.3 from the text]

## UNIT II

Linear Transformations (continued) and Elementary Canonical Forms
[Chapter 3 Sections 3.4 – 3.7;Chapter 6 Sections 6.1 to 6.4 from the text ]

## UNIT III

Elementary Canonical Forms (continued), Inner Product Spaces
[Chapter 6. Sections 6.6 & 6.7; Chapter 8 Sections 8.1 & 8.2 from the text]

## REFERENCES

1. P.R. Halmos : Finite Dimensional Vector spaces
Narosa Pub House, New Delhi (1980)

2. S. Lang : Linear Algebra
Addison Wesley Pub.Co.Reading, Mass (1972)

3. I.N. Herstein : Topics in Algebra
Wiley Eastern Ltd Reprint (1991)

4. N.H. McCoy and R. Thomas : Algebra
Allyn Bacon Inc NY (1977)

5. S. Mac Lane and G. Bikhrkhoff : Algebra
Macmillan Pub Co NY (1967)

6. R.R. Stoll and E.T.Wong : Linear Algebra
Academic Press International Edn (1968)

7. G.D. Mostow and J.H. Sampson : Linear Algebra
McGraw-Hill Book Co NY (1969

8. T.W. Hungerford : Algebra
Springer Verlag GTM No 73 (1974)

9. S. Kumaresan : Linear Algebra-A Geometric Approach
Prentice Hall of India (2000)

10. J. B. Fraleigh& R.H. Beauregard : Linear Algebra
Addison Wesley

11. Henry Helson               : Linear Algebra (Second Edition) Hindustan Book Agencies, 1994.

12. E.D. Ncring               : Linear Algebra and Matrix Theory Wiley International Edition 1963

13. Sheldon Axler             : Linear Algebra Done Right (Second Edition) Springer 1997

14. David C. Lay              : Linear Algebra and its Application, Pearson Education 2003.

## MT1C03 : REAL ANALYSIS - I

**No. of Credits : 4**

No. of hours of Lectures / week  : 5

TEXT:  **RUDIN, W.,**  PRINCIPLES OF MATHEMATICAL ANALYSIS
(3$^{rd}$ Edn.) Mc. Graw-Hill, 1986.

### UNIT – I

Basic Topololgy – Finite, Countable and Uncountable sets Metric Spaces, Compact Sets, Perfect Sets, Connected Sets.

Continuity - Limits of function, Continuous functions, Continuity and compactness, continuity and connectedness, Discontinuities, Monotonic functions, Infinite limits and Limits at Infinity.
[Chapter   2 & Chapter 4]

### UNIT – II

Differentiation – The derivative of a real function, Mean Value theorems, The continuity of Derivatives, L Hospital's Rule, Derivatives of Higher Order, Taylor's Theorem, Differentiation of Vector – valued functions.

The Riemann – Stieltjes Integral, - Definition and Existence of the integral, properties of the integral, Integration and Differentiation.

[Chapters   5 & Chapter 6 up to and including 6.22]

### UNIT – III

The Riemann – Stieltjes Integral (Continued) - Integration of Vector vector-valued Functions, Rectifiable curves.

Sequences and Series   of  Functions - Discussion of Main problem, Uniform convergence, Uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation.  Equicontinuous Families of Functions, The Stone – Weierstrass Theorem.
[Chapters   6 (from 6.23 to 6.27)  & Chapter 7 (upto and including 7.27 only)]

## REFERENCES

1. a) R.G. Bartle : Element of Real Analysis
   Wiley International Edn
   (Second Edn) (1976)

   b) R.G. Bartle and : Introduction to Real Analysis
   D.R. Sherbert   John Wiley Bros (1982)
2. L.M. Graves : The theory of functions of a real variable
   Tata McGraw-Hill Book Co (1978)
3. M.H. Protter & C.B. Moray : A first course in Real Analysis
   Springer Verlag UTM (1977)
4. S.C. Saxena and SM Shah : Introduction to Real Variable Theory
   Intext Educational Publishers
   San Francisco (1972)
5. I.K.Rana : An Introduction to Measure and Integration,
   Narosa Publishing House, Delhi, 1997.
6. Hewitt and Stromberg K : Real and Abstract Analysis
   Springer Verlag GTM 25 (1975) Reprint
7. S.R. Ghorpade & B.V. Limaye : A course in Calculus and Real Analysis, Springer 2006
8. Terence Tao : Analysis I &II
   Hindustan Book agency

**No. of Credits : 4.**

No. of hours of Lectures / week : 5

# MT1C04: ODE AND CALCULUS OF VARIATIONS

TEXT: SIMMONS, G.F.,: DIFFERENTIAL EQUATIONS WITH APPLICATIONS
AND HISTORICAL NOTES,
TMH Edition,-New Delhi, 1974.

## UNIT I

Power Series Solutions and Special functions; Some Special Functions of Mathematical Physics.

[Chapter 5: Sections 26, 27, 28, 29, 30, 31 ; Chapter 6: Sections 32, 33]

## UNIT II

Some special functions of Mathematical Physics (continued)
Systems of First Order Equations; Non linear Equations .

[Chapter 6 : Sections 34, 35 : Chapter 7 :Sections 37, 38, Chapter 8 : Sections 40, 41, 42, 43, 44]

## UNIT III

Oscillation Theory of Boundary Value Problems, The Existence and Uniqueness of Solutions, The Calculus of Variations.

[Chapter 4 : Sections 22, 23 & Appendix A. (Omit Section 24) ; Chapter 11 : Sections 55, 56,57: Chapter 9 : Sections 47, 48, 49]

## REFERENCES

1. G. Birkhoff & G.C. Rota : Ordinary Differential Equations
   Edn. Wiley & Sons 3rd Edn (1978)

2. E.A. Coddington : An Introduction to Ordinary Differential
   Equtions Printice Hall of India, New Delhi (1974)

3. P. Hartman : Ordinary Differential Equations
   John Wiley & Sons (1964)

4. L.S. Pontriyagin : A course in ordinary Differential Equations
   Hindustan Pub. Corporation, Delhi (1967)

5. Courant R and Hilbert D : Methods of Mathematical Physics , vol I
   Wiley Eastern Reprint (1975)

6. W.E. Boyce & R.C. Deprima : Elementary Differential Equations
   and boundary value problems
   John Wiley & Sons NY 2nd Edn (1969)

7. A. Chakrabarti : Elements of ordinary Differential
   Equations and special functions
   Wiley Eastern Ltd New Delhi (1990)

8. Ian Sneddon : Elements of Partial Differential Equations
   McGraw-Hill International Edn., (1957)

## MT1C05 : DISCRETE MATHEMATICS
### No. of Credits 4

Number of hours of Lectures / week: 5

TEXTS:
1) DOUGLAS B. WEST, INTODUCTION TO GRAPH THEORY (Second Edition) Pearson Education
2) K.D.JOSHI, FOUNDATIONS OF DISCRETE MATHEMATICS, New Age International (P) Ltd. New Delhi 1989
3) PETER LINZ, AN INTRODUCTION TO FORMAL LANGUAGES AND AUTOMATA. (Second Edition) Narosa Publishing House, New Delhi, 1997.

### UNIT I

Order Relations, Lattices; Boolean Algebra – Definition and Properties, Boolean Functions.
[Chapter 3 (section.3 (3.1-3.11), chapter 4 (sections 1& 2) from text 2]

### UNIT II

What is a graph? Graphs as Models, Matrices and Isomorphism, Paths, Walks, Connected Graphs, Bipartite Graphs, Eulerian circuits, Vertex Degrees, Degree sum formula. Directed Graphs – Definitions and examples. Trees-Basic Properties. Connectivity. Planar Graphs. Embedding and Eulers formula – Restricted Jordan Curve Theorem (Statement only), Dual Graphs, Eulers formula. [Chapter 1: section 1.1 (up to and including 1.1.40), 1.2 (Up to and including 1.2.27), 1.3 (Up to and including 1.3.6), 1.4 (Up to and including 1.4.13)
[Chapter 2: section 2.1 (Up to and including 2.1.5, 2.1.9 to 2.1.11)]
[Chapter 4; section 4.1 (4.1.1, 4.1.2, 4.1.7 to 4.1.11)]
[Chapter 6: section 6.1 (Up to and including 6.1.13, 6.1.21 to 6.1.24) from text 1]

### UNIT III

Automata and Formal Languages: Introduction to the theory of Computation, Finite Automata, Regular Expressions.
[Chapter 1 (sections 1.2 & 1.3); Chapter 2 (sections 2.1, 2.2 & 2.3); Chapter 3 (section 3.1) from Text 3]

### REFERENCES

1. J.A. Bondy and U.S.R. Murty : Graph Theory with applications. Macmillan
2. F. Harary : Graph Theory, Narosa publishers
3. John Clark and Derek Allan Holton : A First look at Graph Theory, Prentice Hall
4. K.R. Parthasarathy : Basic Graph Theory, Tata-Mc Graw Hill
5. R. Balakrishnan & K. Ranganathan : A Text Book of Graph Theory, Springer Verlag.
6. C.L. Liu : Elements of Discrete Mathematics (Second Edition) Mc Graw Hill Book Company 1985.
7. K.H. Rosen : Discrete Mathematics and its Applications (5th Edition) MC Graw Hill 2003.

<div align="center">**SEMESTER II**</div>

## MT2C06 - ALGEBRA – II

**No. of Credits :4**

No.of hours of lectures/week : 5

<div align="center">

**TEXTS : FRALEIGH, J.B. : A FIRST COURSE IN ABSTRACT ALGEBRA**
( Fifth Edn.) Narosa (1999)

### UNIT I
</div>

Prime and Maximal Ideals, Introduction to Extension Fields, Algebraic Extensions (Omit Proof of the Existence of an Algebraic Closure), Geometric Constructions.
[§§ 6.2, 8.1, 8.3, 8.4 ]

<div align="center">

### UNIT II
</div>

Finite Fields, Automorphisms of Fields, The Isomorphism Extension Theorem, Splitting Fields, Separable Extensions.
[§§ 8.5, 9.1, 9.2, 9.3, 9.4 from Text]

<div align="center">

### UNIT III
</div>

Galois Theory, Illustration of Galois Theory, Cyclotomic Extensions, Insolvability of the Quintic.
[§§ 9.6, 9.7, 9.8, 9.9 ]

## REFERENCES

1 . N.H. McCoy and R.Thomas   : Algebra, Allyn & Bacon Inc. (1977).

2   J. Rotman   : The Theory of Groups Allyn & Bacon Inc. (1973)

3. Hall,Marshall   : The Theory of Groups,Chelsea Pub. Co. NY. (1976)

4. Clark, Allan   : Elements of Abstract Algebra
Dover Publications (1984)

5. L.W. Shapiro   : Introduction to Abstract Algebra
McGraw Hill Book Co. NY (1975)

6. C. Musili   : Introduction to Rings and Modules
Narosa Publishing House, New Delhi (1992)

7.  N. Jacobson              :   Basic Algebra , Vol. I.
    Hindustan Publishing Corporation (India),
    Delhi 110 007 Reprint (1991)

8.  P.B. Bhattacharya and    :   First Course in Rings, Fields and Vector Spaces
    S.K. Jain                      Wiley Eastern Ltd., New Delhi (1976)

9.  T.W. Hungerford        :   Algebra
    Springer Verlag GTM 73 (1987) 4th Printing

10. I.N.Herstein             :   Topics in Algebra. New York, Blaisdell. 1964

11. F Lorenz                :   Algebra: Volume I: Fields and Galois Theory,
    Univesitext, Springer

12. P. Morandi            :   Fields and Galois Theory, Graduate Text in Mathematics,
    Springer

<u>**MT2C07 - REAL ANALYSIS - II**</u>

**No. of Credits : 4**

No.of hours of Lectures / week : 5

TEXTS: 1 **RUDIN, W.,** PRINCIPLES OF MATHEMATICAL ANALYSIS
(3$^{rd}$ Edn.) Mc. Graw-Hill, 1986.
2 **ROYDEN,H.L,** REAL ANAYLSIS
(3$^{rd}$ Edn.) Macmillan Publishing company.

## <u>UNIT – I</u>

Functions of Several Variables – Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem, Determinants.
[Chapter 9 – Sections 1-29, 33-38 from Text – 1 ]

## <u>UNIT – II</u>

Set Theory - Algebras of Sets.

Lebesgue Measure – Introduction, Outer Measure, Measurable Sets and Lebesgue Measure. A Non Measurable Set, Measurable Functions, Little Wood's Three Principles.

The Lebesgue Integral - The Riemman Integral, The Lebesgue Integral of a Bounded Function Over a Set of Finite Measure, The Integral of a Non Negative Function, The General Lebesgue Integral, Convergence in Measure.
[Chapter 1 Section –4, Chapter 3 – All Sections & Chapter 4 – Sections 1,2,3 from Text 2]

## <u>UNIT – III</u>

The Lebesgue Integral - The General Lebesgue Integral, Convergence in Measure.

Differentiation of Monotone Functions, Functions of Bounded Variations. Differentiation of an Integral. Absolute Continuity.
[Chapter 4 – Sections 4,5 & Chapter 5, Sections 1,2,3, 4 from Text 2 ]

<u>**REFERENCES**</u>

1. a) R.G. Bartle         : Elements of Real Analysis
                              Wiley International Edn
                              (Second Edn) (1976)

   b) R.G. Bartle and      : Introduction to Real Analysis
      D.R. Sherbert          John Wiley Bros. (1982)

2. L.M. Graves : The Theory of Functions of a Real Variable
Tata McGraw-Hill Book Co (1978)

3. M.H. Protter & C.B. Moray : A First course in Real Analysis
Springer Verlag UTM (1977)

4. S.C. Saxena and SM Shah : Introduction to Real Variable Theory
Intext Educational Publishers
San Francisco (1972)

5. I.K. Rana : An Introduction to Measure and Integration,
Narosa Publishing House, Delhi, 1997, 2$^{nd}$ Edn.

6. E. Hewitt and K. Stromberg : Real and Abstract Analysis
Springer Verlag GTM 25 (1975) Reprint

7. P. R. Halmos : Measure Theory, Graduate Texts in Mathematics,
Springer

8. R. G. Bartle : The Elements of Integration and Lebesgue Measure,
Wiley (1995)

9. K.B. Athreya & S. Lahiri : Measure Theory, TRIM 36, Hindustan Book Agency

## MT2C08 - TOPOLOGY – I

**No. of Credits : 4**

No.of hours of Lectures / week : 5

TEXT: **JOSHI, K.D.,** INTRODUCTION TO GENERAL TOPOLOGY
(Revised Edition) Wiley Eastern Ltd., New Delhi, 1984

### UNIT I

A Quick Revision of Chapter 1,2 and 3. Topological Spaces, Basic Concepts
[Chapter 4 and Chapter 5 Sections 1, Section 2 (excluding 2.11 and 2.12) and Section 3 only]

### UNIT II

Making Functions Continuous, Quotient Spaces, Spaces with Special Properties
[Chapter 5 Section 4 and Chapter 6]

### UNIT III

Separation Axioms: Hierarchy of Separation Axioms, Compactness and Separation Axioms, The Urysohn Characterization of Normality, Tietze Characterisation of Normality. [Chapter 7: Sections 1 to 3 and Section 4 (up to and including 4.6)]

### REFERENCES

1. J .Dugundji : Topology
   Prentice Hall of India (1975)

2. S.Willard : General Topology
   Addison Wesley Pub Co., Reading Mass (1976)

3. G.F. Simmons : Introduction to Topology and Modern Analysis
   McGraw-Hill International Student Edn. (1963)

4. M. Gemignani : Elementary Topology
   Addison Wesley Pub Co Reading Mass (1971)

5. M.G. Murdeshwar : General Topology (Second Edition )
   Wiley Eastern Ltd (1990)

6. M.A. Armstrong : Basic Topology, Springer Verlag
   New York 1983

7. J. R. Munkres : Topology- a First Course, PHI

8. Fred H. Croom : Principles of Topology, Cengage Learning Asia

# MT2C09 - PDE AND INTEGRAL EQUATIONS

**No. of Credits : 4**
No. of hours of Lectures / week : 5

TEXTS : 1. **AMARNATH, M., : PARTIAL DIFFERENTIAL EQUATIONS**
Narosa , New Delhi (1997)

2. **HILDEBRAND, F.B.:** METHODS OF APPLIED MATHEMATICS
(Second Edn.) Prentice-Hall of India, New Delhi, 1972.

## UNIT I

First Order PDE .

[Sections 1.1 – 1.11. from the Text 1 ]
Omit the Proof of Theorem 1.11.1

## UNIT II

Second Order PDE
[Sections 2.1 – 2.5. from the Text 1]

## UNIT III

Integral Equations.

[Sections 3.1 – 3.3, 3.6 – 3.11 from the Text 2]

## REFERENCES

1. G. Birkhoff & G.C. Rota      : Ordinary Differential Equations
Edn. Wiley & Sons 3rd Edn (1978)

2. E.A. Coddington      : An Introduction to Ordinary Differential Equations
Printice Hall of India, New Delhi (1974)

3. P. Hartman      : Ordinary Differential Equations
John Wiley & Sons (1964)

4. L.S. Pontriyagin      : A Course in Ordinary Differential Equations
Hindustan Pub. Corporation, Delhi (1967)

5. F. John      : Partial Differential Equations
Narosa Pub. House New Delhi (1986)

6. Phoolan Prasad &      : Partial Differential Equations
Renuka Ravindran      Wiley Eastern Ltd New Delhi (1985)

7. R. Courant and D. Hilbert      : Methods of Mathematical Physics , Vol I
Wiley Eastern Reprint (1975)

8. W.E. Boyce & R.C. Deprima      : Elementary Differential Equations
and Boundary Value Problems
John Wiley & Sons, NY, 9th Edition

9. A. Chakrabarti      : Elements of Ordinary Differential
Equations and Special Functions
Wiley Eastern Ltd New Delhi (1990)

10. Ian Sneddon      : Elements of Partial Differential Equations
McGraw-Hill International Edn., (1957)

## MT2C10 - NUMBER THEORY

**No. of Credits : 4**

No.of hours of Lectures / week : 5

### TEXTS :

1.  APOSTOL, T.M.,: INTRODUCTION TO ANALYTIC NUMBER THEORY , Narosa Publishing House, New Delhi 1990.

2.  KOBLITZ , NEAL:A COURSE IN NUMBER THEORY AND CRYPTOGRAPHY, Springer–Verlag , New York (1987).

### UNIT I

Arithmetical Functions and Dirichlet Multiplication ; Averages of Arithmetical Functions; Some Elementary Theorems on the Distribution of Prime Numbers.
[Chapter 2 Sections 2.1 to 2.14, 2.18, 2.19 ;  Chapter 3 Sections 3.1 to 3.4, 3.9 to 3.12;  Chapter 4 Sections 4.1 to 4.10 of Text 1]

### UNIT II

Congruences, Quadric Residues and Quadratic Reciprocity Law.
[Chapters 5 ( All Sections) and Chapter 9 Sections 9.1 to 9.7 of Text 1]

### UNIT III

Cryptography, Public Key.
[Chapter 3 and 4 of Text 2.]

### REFERENCES

1. W.W Adams &         :  Introduction to Number Theory
   L.J. Goldstein          Printice Hall Inc.,Engelwoods, (1976)
2. W.J. Le Veque       :  Topics in Number Theory ,Vols. I & II
                          Addison Wesley Pub. Co. Readings Mass (1961).
3. A.Hurwitz & N.Kritiko  :  Lectures on Number Theory
                          Springer Verlag ,Universitext (1986)
4. H. Davenport        :  The Higher Arithmetic
                          Cambridge Univ.Press, Sixth Edn. (1992)
5. Kenneth H. Rosen    :  Elementary Number Theory and its Applications
                          Addison Wesley Pub Co., $3^{rd}$ Edn. (1993)
6. G.H. Hardy & E. M.Wright  :  An Introduction to the Theory of Numbers
                          Oxford International Edn (1985)
7. D.P.Parent          :  Exercises in Number Theory
                          Springer Verlag,(Problem Books in Math) 1984
8. Don Redmond         :  Number Theory
                          Monographs & Texts in Mathematics No: 220
                          Marcel Dekker Inc (1994).
9. Thomas Koshy        :  Elementary Number Theory with Applications
                          Harcourt / Academic Press 2002

10. Douglas R Stinson     : Cryptography- Theory and Practice (2nd edn.)
Chapman & Hall / CRC (2002)

11. Simon Singh     : The Code Book
The Fourth Estate, London (1999)

12. Song Y.Yan     : Number Theory for Computing (2nd Edition)
Springer – Verlag 2002

13. Oystein Ore     : Number Theory and its History –
Mc Graw – Hill Book Company 1948

14. Paulo Ribenboim     : The Little Book of Big Primes
Springer-Verlag (New York 1991)

15. Albrecht Beautelspacher     : Cryptology Mathematical Association of America
(Incorporated),1994

16. G. Everest and T.Ward     : An Introduction to Number Theory, GTM 232, Springer.

17. Erickson & Vazzana     : Introduction to Number Theory, Chapman & Hall,
Indian Edition.

## MT3C11 : COMPLEX ANALYSIS
No. of Credits : 4
Number of hours of Lectures/week : 5

TEXTS : AHLFORS, L.V. : COMPLEX ANALYSIS
3$^{rd}$ Edn. Mc Graw Hill International Student Edn. (1979)

### UNIT I

Conformality, Linear Transformations, Elementary Conformal Mappings, Fundamental Theorems.
[§§ 3.2, 3.3, 3.4, 4.1]

### UNIT II

Cauchy's Integral Formula, Local Properties of Analytic Functions, The General Form of Cauchy's Theorem, Calculus of Residues.
[§§ 4.2, 4.3, 4.4, 4.5]

### UNIT III

Harmonic functions, Power series Expansions, Simply Periodic Functions, Doubly Periodic Functions, The Weierstrass Theory.
[§§ 4.6, 5.1, 7.1, 7.2, 7.3]

### REFERENCES

1. Cartan, H. : Elementary Theory of analytic functions of one or several variables, Addison - Wesley Pub. Co. (1973).

2. Conway, J.B : Functions of One Complex Variable, Narosa Pub. Co., New Delhi (1973).

3. Moore, T.O., & Hadlock, E.H. : Complex Analysis, Series in Pure Mathematics - Vol. 9. World Scientific (1991).

4. Pennisi, L. : Elements of Complex Variables, Holf, Rinehart & Winston, 2$^{nd}$ Edn. (1976).

5. Rudin, W. : Real and Complex Analysis, 3$^{rd}$ Edn. Mc Graw - Hill International Editions. (1987).

6. Sliverman, H. : Complex Variables Houghton Mifflin Co. Boston (1975)

7. Remmert, R. : Theory of Complex Functions UTM, Springer-Verlag, NY, (1991)

## MT3C12 : FUNTIONAL ANALYSIS I

**No. of Credits : 4**

Number of hours of Lectures/week : 5

TEXT :  LIMAYE , B.V  :  FUNCTIONAL  ANALYSIS
(2nd Edn.) New Age International Ltd, Publishers
New Delhi, Bangalore (1996)

### UNIT 1

Metric spaces and Continuous Functions (section 3,   3.1 to 3.3 & 3.4(without proof), 3.11 to 3.13) Lp spaces , Fourier series and Integrals (section 4.5 to 4.11), Normed spaces (section 5).

### UNIT II

Continuity of linear maps ( section 6), Inner product spaces , Orthonormal sets (Sections 21 and 22), Approximation and Optimization( section 23 , except 23.6)

### UNIT III

Hahn-Banach Theorems (section 7, omit Banach limits), Banach spaces (section 8) Uniform Boundedness Principle (section 9, omit Quadrature Formulae and Matrix Transformations and Summability Methods).

## REFERENCES

1. R. Bhatia.                           : Notes on Functional Analysis  TRIM series,  Hindustan Book Agency

2. Kesavan S,                         : Functional Analysis  TRIM series, Hindustan Book Agency

3. S David Promislow              : A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008).

4. Sunder V.S,                       : Functional Analysis TRIM Series, Hindustan Book Agency

5. George Bachman  & Lawrence Narici         : Functional Analysis Academic Press, NY (1970)

6. Kolmogorov  and Fomin S.V.    : Elements  of the Theory of Functions and Functional Analysis. English Translation, Graylock Press Rochaster NY (1972)

7. W. Dunford and J. Schwartz    : Linear Operators Part 1, General Theory John Wiley & Sons (1958)

8. E.Kreyszig                         : Introductory Functional Analysis with Applications John Wiley & Sons (1978)

9. F. Riesz and B. Nagy : Functional Analysis
Frederick Unger NY (1955)

10. J.B.Conway : Functional Analysis
Narosa Pub House New Delhi (1978)

11. Walter Rudin : Functional Analysis
TMH edition (1978)

12. Walter Rudin : Introduction to Real and Complex Analysis
TMH edition (1975)

13. J.Dieudonne : Foundations of Modern Analysis
Academic Press (1969)

14. Yuli Eidelman, Vitali Milman : Functional analysis An Introduction,
and Antonis Tsolomitis Graduate Studies in Mathematics
Vol. 66 American Mathematical Society 2004.

## MT3C13 : TOPOLOGY  II

**No. of Credits : 4**

No. of hours of Lectures / week  : 5

TEXT  1 : **K.D. JOSHI**          :INTRODUCTION TO GENERAL TOPOLOGY
(Revised Edition) Wiley Eastern Ltd 1984

TEXT 2 : **JAMES. R. MUNKRES**: Topology – A First Course, Prentice Hall of India
Private Ltd., New Delhi.

## UNIT I

Tietze Characterisation of Normality, Products and Co products
[Chapter 7 Section 4 (4.7 & 4.8 only), Chapter 8, Section 1,2,3 and Section 4 up to and including
4.2 only]

## UNIT II

Embedding and Metrization, The Fundamental Groups and Covering Spaces
[Chapter 9 of Text 1 and Chapter 8 Sections 8.1 to 8.5 of Text 2.]

## UNIT III

Compactness, Complete Metric Spaces
[Chapter 11 Sections 1,2 (up to and including 2.7), 3 and  4 (up to and including 4.14 only),
Chapter 12 Section 1 (up to and including 1.6 only), Section 2 up to and including 2.6 only ,
Section 4 up to and including 4.5 only]

## REFERENCES

1. Dugundji. J.          :  Topology
   Prentice Hall of India (1975)

2. Willard. S.          :  General Topology
   Addison Wesley Pub Co., Reading Mass (1976)

3. Simmons G.F.          :  Introduction to Topology and Modern Analysis
   McGraw-Hill International Student Edn (1963)

4. M. Gemignani          :  Elementary Topology
   Addison Wesley Pub Co Reading Mass (1971)

5. Fred H. Croom          :  Basic Concepts of Algebraic Topology
   UTM, Springer Verlag, NY(1978)

6. M.G. Murdeshwar          :  General Topology (Second Edition)
   Wiley Eastern Ltd (1990)

7. M.A. Armstrong          :  Basic Topology, Springer Verlag
   New York 1983
   ISBN 0-387-90839-0

# MT3C14 : LINEAR PROGRAMMING AND ITS APPLICATIONS

**No. of Credits : 4**

No. of hours of Lecture/week: 5

TEXT : **K.V.MITAL; C. MOHAN** : OPTIMIZATION METHODS IN
OPERATIONS RESEARCH AND
SYSTEMS ANALYSIS
($3^{rd}$. Edn.) New Age International (P) Ltd. Pub.

## UNIT I

1. CONVEX SETS
2. EXTREMA OF FUNCTIONS
3. LINEAR PROGRAMMING

[Chapter 1 (section 11 to 19); Chapter 2 (all sections); Chapter 3 (sections 1 to 8) from the text]

## UNIT II

4. MORE ON LINEAR PROGRAMMING (Omit Revised Simplex method)
5. TRANSPORTATION PROBLEM

[Chapter 3 (sections 9 to 15, 17 to 22); Chapter 4 (sections 1 to 10) from the text]

## UNIT III

6. ASSIGNMENT PROBLEM
7. INTEGER LINEAR PROGRAMMING
8. THEORY OF GAMES

[Chapter 4 (sections 11 to 16); Chapter 6 (sections 1 to 6) and Chapter 12 (all sections) from the text]

## REFERENCES

1. G. Hadley : Linear Programming
   Addison-Wesley Pub Co Reading, Mass (1975)

2. G. Hadley : Non-linear and Dynamic Programming
   Wiley Eastern Pub Co. Reading, Mass (1964)

3. S.S. Rao : Optimization – Theory and Applications
   ($2^{nd}$ Edn.) Wiley Eastern (P) Ltd. New Delhi.

4. Russel L Ackoff and : Fundamentals of Operation Research
   Maurice W.Sasioni    Wiley Eastern Ltd. New Delhi. (1991)

5. Charles S. Beightler, : Foundations of Optimization
   D.T. Philiphs & D.J. Wilde    ($2^{nd}$ Edn.) Prentice Hall of India, Delhi (1979)

6. Hamdy A. Taha : Operations Research: An Introduction
   ($4^{th}$ Edn.) Macmillan Pub Co. Delhi (1989)

## MT4C15 : FUNCTIONAL ANALYSIS II

**No. of Credits : 4**

Number of hours of Lectures/week : 5

TEXT : **LIMAYE , B.V** : FUNCTIONAL ANALYSIS
(2nd Edn.) New Age International Ltd, Publishers
New Delhi, Bangalore (1996)

## UNIT I

Closed Graph and Open Mapping Theorems (section 10) , Bounded Inverse Theorems (section 11) , Spectrum of a Bounded Operator ( section 12), Duals and Transposes (section 13, upto and including 13.6).

## UNIT II

Reflexivity (section 16, Omit 16.3 and the proof of 16.5 and 16.6), Definition of Compact Linear Map, Projection and Riesz Representation Theorems ( section 24).

## UNIT III

Bounded Operators and Adjoints ( section 25), Normal, Unitary and Self Adjoint Operators ( section 26, omit Fourier-Plancherel Transform), Spectrum and Numerical Range (section 27), Compact self Adjoint Operators ( section 28 , omit 28.7 and 28.8(b)).

## REFERENCES

1. R. Bhatia. : Notes on Functional Analysis TRIM series, Hindustan Book Agency

2. Kesavan S. : Functional Analysis TRIM series, Hindustan Book Agency

3. S David Promislow : A First Course in Functional Analysis Wiley Interscience, John wiley & Sons, INC., (2008.)

4. Sunder V.S. : Functional Analysis TRIM Series, Hindustan Book Agency

7. George Bachman & Lawrence Narici : Functional Analysis Academic Press, NY (1970)

8. Kolmogorov and Fomin S.V. : Elements of the Theory of Functions and Functional Analysis. English Translation, Graylock Press Rochaster NY (1972)

7. W. Dunford and J. Schwartz : Linear Operators Part 1, General Theory John Wiley & Sons (1958)

8.  E.Kreyszig   : Introductory Functional Analysis with Applications
        John Wiley & Sons (1978)

9.  F. Riesz and B. Nagy   : Functional Analysis
        Frederick Unger NY (1955)

10. J.B.Conway   : Functional Analysis
        Narosa Pub House New Delhi (1978)

11. Walter Rudin   : Functional Analysis
        TMH edition (1978)

12. Walter Rudin   : Introduction to Real and Complex Analysis
        TMH edition (1975)

13. J.Dieudonne   : Foundations of Modern Analysis
        Academic Press (1969)

14. Yuli Eidelman, Vitali Milman   : Functional analysis An Introduction,
   and Antonis Tsolomitis    Graduate Studies in Mathematics
        Vol. 66 American Mathematical Society 2004.

## MT4C16 : DIFFERENTIAL GEOMETRY

**No. of Credits : 4**

No. of hours of Lectures/week : 5

### TEXT: **J.A.THORPE** : ELEMENTARY TOPICS IN DIFFERENTIAL GEOMETRY
Springer – Verlag, New York.

### UNIT I

Graphs and Level Set, Vector fields, The Tangent Space, Surfaces, Vector Fields on Surfaces, Orientation. The Gauss Map.
[Chapters : 1,2,3,4,5,6 from the text.]

### UNIT II

Geodesics, Parallel Transport, The Weingarten Map, Curvature of Plane Curves, Arc Length and Line Integrals.
[Chapters : 7,8,9,10,11 from the text].

### UNIT III

Curvature of Surfaces, Parametrized Surfaces, Local Equivalence of Surfaces and Parametrized Surfaces.
[Chapters 12,14,15 from the text]

### REFERENCES

1.  W.L. Burke               :   Applied Differential Geometry
                                 Cambridge University Press (1985)

2.  M. de Carmo             :   Differential Geometry of Curves and Surfaces
                                 Prentice Hall Inc Englewood Cliffs NJ (1976)

3.  V. Grilleman and A. Pollack :  Differential Topology
                                 Prentice Hall Inc Englewood Cliffs NJ (1974)

4.  B. O'Neil               :   Elementary Differential Geometry
                                 Academic Press NY (1966)

5.  M. Spivak               :   A Comprehensive Introduction to Differential
                                 Geometry, (Volumes 1 to 5)
                                 Publish or Perish, Boston (1970, 75)

6.  R. Millmen and G. Parker :   Elements of Differential Geometry
                                 Prentice Hall Inc Englewood Cliffs NJ (1977)

7   I. Singer and J.A. Thorpe  :   Lecture Notes on Elementary Topology and Geometry
                                 UTM, Springer Verlag, NY (1967)

## MT4E0 ǀ : FLUID DYNAMICS

**No. of Credits : 4**
No. of hours of Lectures/week : 5

TEXT : L.M. MILNE-THOMSON : THEORETICAL HYDRODYNAMICS
(Fifth Edition) Mac Millan Press, London, 1979.

### UNIT I

EQUATIONS OF MOTION : Differentiation w.r.t. the time, The equation of continuity Boundary condition (Kinematical and Physical), Rate of change of linear momentum, The equation of motion of an invicid fluid, Conservative forces, Steady motion, The energy equation, Rate of change of circulation, Vortex motion, Permanence of vorticity, Pressure equation, Connectivity, Acyclic and cyclic irrotational motion, Kinetic energy of liquid, Kelvin's minimum energy theorem.

TWO-DIMENSIONAL MOTION : Motion in two-dimensions, Intrinsic expression for the vorticity; The rate of change of vorticity; Intrinsic equations of steady motion; Stream function; Velocity derived from the stream-function; Rankine's method; The stream function of a uniform stream; Vector expression for velocity and vorticity; Equation satisfied by stream function; The pressure equation; Stagnation points; The velocity potential of a liquid; The equation satisfied by the velocity potential.

[Chapter III: Sections 3.10, 3.20, 3.30, 3.31, 3.40, 3.41, 3.43, 3.45, 3.50, 3.51, 3.52, 3.53, 3.60, 3.70, 3.71, 3.72, 3.73. Chapter IV : All Sections.]

### UNIT II

STREAMING MOTIONS : Complex potential; The complex velocity stagnation points, The speed, The equations of the streamlines, The circle theorem, Streaming motion past a circular cylinder; The dividing streamline, The pressure distribution on the cylinder, Cavitation, Rigid boundaries and the circle theorem, The Joukowski transformation, Theorem of Blasius.

AEROFOILS: Circulation about a circular cylinder, The circulation between concentric cylinders, Streaming and circulation for a circular cylinder, The aerofoil, Further investigations of the Joukowski transformation Geometrical construction for the transformation, The theorem of Kutta and Joukowski.

[Chaper VI : Sections 6.0, 6.01, 6.02, 6.03, 6.05, 6.21, 6.22, 6.23, 6.24, 6.25, 6.30, 6.41.
Chapter VII: Sections 7.10, 7.11, 7.12, 7.20, 7.30, 7.31, 7.45.]

## UNIT III

SOURCES AND SINKS: Two dimensional sources, The complex potential for a simple source, Combination of sources and streams, Source and sink of equal strengths Doublet, Source and equal sink in a stream, The method of images, Effect on a wall of a source parallel to the wall, General method for images in a plane, Image of a doublet in a plane, Sources in conformal transformation Source in an angle between two walls, Source outside a circular cylinder, The force exerted on a circular cylinder by a source.

STKOKES' STREAM FUNCTION: Axisymmetrical motions Stokes' stream function, Simple source, Uniform stream, Source in a uniform stream, Finite line source, Airship forms, Source and equal sink - Doublet; Rankin's solids.
[Chapter VIII. Sections 8.10, 8.12, 8.20, 8.22, 8.23, 8.30, 8.40, 8.41, 8.42, 8.43, 8.50, 8.51, 8.60, 8.61, 8.62. Chapter XVI.   Sections 16.0, 16.1, 16.20, 16.22, 16.23, 16.24, 16.25, 16.26, 16.27]

## REFERENCES

1.  Von Mises and K.O. Friedrichs    :    Fluid Dynamics
                                           Springer International Edition. Reprint, (1988)

2.  James EA John                    :    Introduction to Fluid Mechanics  (2$^{nd}$ Edn.)
    William L Haberman                    Prentice Hall of India ,Delhi,(1983). Reprint.

3.  Chorlten                         :    Text Book of Fluid Dynamics
                                           CBS Publishers, Delhi 1985

4.  A. R. Patterson                  :    A First Course in Fluid Dynamics
                                           Cambridge University Press 1987.

## MT4E02 : OPERATIONS RESEARCH
**No. of Credits : 4**

No. of hours of Lecture/week : 5

TEXT : **K.V.MITAL; C. MOHAN** : OPTIMIZATION METHODS IN
OPERATIONS RESEARCH AND
SYSTEMS ANALYSIS
(3rd. Edn.) New Age International (P) Ltd. Pub.

## UNIT I

FLOW AND POTENTIAL IN NETWORKS
ADDITIONAL TOPICS IN LINEAR PROGRAMMING
[Chapter 5 (all sections);Chapter 7 (sections 1 to 15) ]

## UNIT II

QUADRATIC PROGRAMMING
GEOMETRIC PROGRAMMING
[Chapter 8 (sections 1 to 6);Chapter 9 (omit section 5)]

## UNIT III

DYNAMIC PROGRAMMING
DIRECT SEARCH AND GRADIENT METHOD
[Chapter 10 (sections 1 to 10); Chapter 11 (sections 1 to 14)]

## REFERENCES

1. G. Hadley : Linear Programming
Addison-Wesley Pub Co Reading, Mass (1975)

2. G.Hadley : Non-linear and Dynamic Programming
Wiley Eastern Pub Co.Reading, Mass (1964)

3. S.S. Rao : Optimization - Theory and Applications
(2nd Edn.)Wiley Eastern (P)Ltd. New Delhi

4. Russel L Ackoff and : Fundamentals of Operation Research
Maurice W.Sasioni Wiley Eastern Ltd. New Delhi (1991)

5. Charles S. Beightler, : Foundations of Optimization
D.T. Philiphs & D.J. Wilde (2nd Edn.) Prentice Hall of India, Delhi (1979)

6. Hamdy A. Taha : Operations Research : An Introduction
(4th Edn.)Macmillan Pub Co. Delhi (1989)