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UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/55/2024-25

Dated: 20.07.2024

Notification

Sub:-Syllabus and Scheme of Examinations of Mathematics (UG) Programme (I & II Semester) from the Academic year 2024-25.

Ref:-1. Decision of Board of Studies in Mathematics (CB) meeting held on 06-06-2024.
2. Decision of the Faculty of Science & Technology meeting held on 19-06-2024.
3. Decision of the Academic Council meeting held on 28.06.2024.

*****

The Board of Studies in Mathematics (CB) which met on 06-06-2024 has resolved to recommend& approved the Syllabus and Scheme of examinations of Mathematics (UG) programme (I & II Semester) with effect from the Academic year 2024-25.

The Faculty of Science & Technology and Academic Council at their meetings held on 19-06-2024 and 29-06-2024 respectively has also approved the above said Syllabus and Scheme of examinations hence it is hereby notified.

The Syllabus and Scheme of Examinations content may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

Registrar

Registrar
University of Mysore
Mysore

To;

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS in Mathematics, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DOS in Mathematics, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council, Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
10. Office Copy.

UNIVERSITY OF MYSORE

Bachelor of Science (B.Sc.) Semester Scheme(SEP)
Curriculum structure for undergraduate Programme for 2024-25
Syllabus for Mathematics

Sem	Sl. No.	Code	Title of the Paper		Teaching Hours/week	Credit Pattern L:T:P	Credit Value	marks		
								C1	C2	C3
I	01	DSC-MAT-01	Algebra-I and Calculus-I	Practical-01	3+4	3:0:2	5	10	10	80
II	02	DSC-MAT-02	Algebra-II and Calculus-II	Practical-02	3+4	3:0:2	5	10	10	80

Assessment Pattern for Theory

Assessments comprise broadly of two components namely formative and summative which should be in the proportion of 20% : 80%.

1. **Formative or Internal Assessments.** This should comprise of two components namely C_1 and C_2. Each of C_1 and C_2 should carry equal weights (namely 10 marks each).
   (a) C_1 **component.** A test must be conducted for 10 marks in the eighth week.
   (b) C_2 **component.** Any of the assessments such as seminar/assignment/quiz can be conducted for 10 marks or a test can be conducted for 10 marks.
2. **Summative Assessment.** This may be named as C_3 component and this should be conducted for 80 marks. The question paper pattern should be as follows:

PART - A

1. **Question 1.** Answering 10 questions out of 12 questions each carrying 2 marks. (Total 20 marks) and four questions from each of the unit should be given.

PART-B

2. **Question 2.** (Answer any two. From Unit 1 and carries 10 marks)
   (a) (5 marks)
   (b) (5 marks)
   (c) (5 marks)

PART -C

3. **Question 3.** (Answer any two. From Unit 2 and carries 10 marks)
   (a) (5 marks)
   (b) (5 marks)
   (c) (5 marks)

Part - D

4. **Question 6.** (Answer any two. From Unit 3 and carries 10 marks)
   (a) (5 marks)
   (b) (5 marks)
   (c) (5 marks)

PART E

5. **Question 8.** Answering 6 out of 9 question each carrying 5 marks (Total 30 marks) and three questions from each of the unit should be given.

Assessment Pattern for Practical

Assessment comprises of two components namely formative and summative which should be in the proportion of 20%-80% (10 marks & 40 marks)

1. **Formative or Internal Assessment:** This should comprise of two components namely C1 and C2. C1 should carry 05 marks and C2 should carry 05 marks.
   (a) **C1 Component:** Internal test should be conducted for 05 marks in the eighth or ninth week.
   (b) **C2 Component:** Assignment comprising of two programs of his/her own apart from the programs prescribed in the lab manual (if any) has to be submitted for 05 marks in the fifteenth or sixteenth week
2. **Summative Assessment:** This may be named as C3 component and this should be conducted for 40 marks of 3 hrs duration. Practical related viva voice should be conducted for 5 marks and record should be evaluated for 5 marks. A test of writing and executing programs should be conducted for 30 marks. The question paper pattern should be as follows:

Question: Answering 3 out of 4 questions each carrying 10 marks (Total 30 marks). Programs from each unit should be given.

SYLLABUS
Semester-I
Algebra - I and Calculus I

Unit I - Mathematical Logic and Boolean Algebra

16 hours

Introduction to propositional logic: Propositions, logical connectors, truth tables, logical equivalences, tautology, contradiction and contingent statements, negations, contra positive, converse and inverses of given statements; **Theory of inference:** Modus Ponens, Modus Tollens, Hypothetical Syllogism, Disjunctive syllogism (Premises, conclusion and tautology governing them); **Methods of proofs:** Discussion on necessity of proof, direct proofs, contradiction method, contrapositive method and mathematical induction (explanation with simple examples);
Boolean Algebra: Definition, examples, laws of Boolean Algebra; Normal disjunctive form, prime implicants, Karnaugh map theorem for reducing logical circuits.

Unit II - Theory of equations

16 hours

Polynomials: Euclid's algorithm, Polynomials with integral coefficients, Remainder theorem, Factor theorem, Fundamental theorem of algebra(statement only); **Some facts and concepts:** Synthetic division method, Irrational and complex roots occurring in conjugate pairs, Relation between roots and coefficients of a polynomial equation, Symmetric functions, Transformation, Reciprocal equations, Descartes' rule of signs, Multiple roots, Standard methods: Solving cubic equations by Cardon's method, Solving quartic equations by Descarte's Method.

Unit III - Introduction to Calculus

16 hours

Limits and Continuity. Introduction to real number system, intervals, concepts of supremum and infimum (introduction with examples), least upper bound axiom (mention), Archimedian property (proof); **Introduction to limits:** $\epsilon - \delta$ definition of limits, problems on verifying limits through $\epsilon - \delta$ definition, concepts of left hand limit and right hand limit (definition and problems), Algebra of limits, continuity of a function, algebra of continuous functions, some standard examples of continuous functions; **Differentiability:** Definition, concepts of left hand and right hand derivatives; **Leibnitz theorem and its applications.** Successive differentiation, n^{th} - derivatives of standard functions, Leibnitz theorem (with proof) and applications; **Polar coordinates.** Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), Derivative of an arc in Cartesian, parametric and polar forms (Derivation and problems).

References.

Unit I

1. For the methods of proofs
   (a) Discrete Mathematics and its Applications, *Kenneth Rosen*, Tata McGrawhill

(b) The tools of Mathematical Reasoning, *Tamara J. Lankins*

(c) A textbook of B.Sc. Mathematics - Part I, *G K Ranganath and C S Sampangiram*

(d) College Mathematics, *N Rudraiah*, Sapna Book House

2. For the inference theory of propositional and predicate logic

   (a) A textbook of B.Sc. Mathematics - Part I, *G K Ranganath and C S Sampangiram*, S. Chand publications

   (b) College Mathematics, *N Rudraiah*, Sapna Publications

3. For Boolean algebra

   (a) A Beginner's Guide to Discrete Mathematics, *W. D. Wallis*, Second Edition, Birkhäuser, (2023) [Chapter 3].

Unit II.

1. Theory of equations, *J. V. Uspensky*, McGraw-Hill Inc..US
2. University Algebra, *N.S. Gopala Krishnan*, New Age International (P) Limited.
3. Algebra, *Natarajan, Manicavasagam Pillay and Ganapathy.*

Unit III

1. Schaum's Outline of Calculus, *Frank Ayres and Elliott Mendelson*, 5th ed. USA:Mc. Graw Hill, 2008.
2. Differential Calculus, *Shantinarayan*, S. Chand & Company, New Delhi.
3. Calculus, *Shanthinarayanan & T. K. Manicavachogam Pillay*, S. Viswanathan Pvt. Ltd., vol. I & II.

Semester I
PRACTICAL 1: ALGEBRA I AND CALCULUS I
(2 Hours/Week per Batch of not more than 19 Students)
Mathematics Practical with FOSS tools for Computer Programs

Suggested Software: Maxima/Scilab/Python/Maple/Matlab/Mathematica/R. At least two programs from each unit should be taught. A total of 10 programs should be taught.

Programs:

Unit 1:

1. Construction of truth tables for compound propositions.
2. Verification of tautology and contradiction.
3. Proving logical equivalence.
4. Problems on Karnaugh map theorem for reducing logical circuits.

Unit 2:

1. Solving polynomial equations - having irrational or complex roots, reciprocal equations, using relation between rootas and coefficients etc.
2. Descarte's rule of signs.
3. Solving cubic equations using Cardon's method.
4. Solving bi-quadratic equations using Descarte's method.

Unit 3:

1. Verification of Limits using $\epsilon - \delta$ definition.
2. Finding limits using the concept of left hand and right hand limits and graphical representation.
3. Problems on Continuity of a function and graphical representation.
4. Problems on Differentiability using first principle and graphical representation.
5. Problems on Leibnitz rule of successive differentiation
6. Problems on Polar coordinates (finding angle between radius vector and the tangent/ finding the angle of intersection of curves).

Semester II
Algebra-II and Calculus II

Unit I - Matrices and Determinants — 16 hours

Recapitulation of matrices and determinants: Types of matrices, symmetric and skew-symmetric, minors, adjoint (mentioning of elementary results), determinant and properties of determinants, algebra of Matrices; **Row - column operations - Echelon form:** Row and column reduction to Echelon form, Rank of a matrix, Inverse of a matrix by elementary operations; **System of linear equations:** Solution of system of linear equations. Criteria for existence of non-trivial solutions of homogeneous system of linear equations, Solution of non-homogeneous system of linear equations; **Cayley-Hamilton theorem (without proof)** Verification, Inverse and powers of matrices by Cayley-Hamilton theorem.

Unit II -Differential Calculus II — 16 hours

Standard theorems on continuous functions on closed intervals. Boundedness, attainment of bounds, intermediate value theorem (with proofs); Additional theorems. Rolle's theorem , Lagrange mean value theorem, generalized Cauchy mean value theorem (Proof and problems); Taylor's theorem - Proof of Taylor's theorem and Problems on Taylor's and Maclaurin's series. Indeterminate forms. L'Hospital rule and related problems, Increasing and decreasing functions, Concavity and convexity; **Multivariable functions.** Functions of two or more variables, Explicit and Implicit functions neighbourhood of a point (for two variable functions), Limits and continuity of two variable functions (Problems);

Unit III - Partial derivatives and Integral Calculus I — 16 hours

Multivariable functions. Partial derivatives. Definition and problems, Homogeneous functions - Euler's theorem and its extension (Proofs and problems), total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.
Integral Calculus: Notion of integration. Recapitulation of definite integral as limit of a sum (without problems), First and second Fundamental theorem of calculus (Only statements), Properties of definite integrals (mention); **Reduction formulas.** Reduction formulae for $\int \sin^n(x)\,dx$, $\int \cos^n(x)\,dx$, $\int \sin^m(x)\cos^m(x)\,dx$, $\int \tan^n(x)\,dx$, $\int \cot^n(x)\,dx$, $\int \sec^n(x)\,dx$, $\int \csc^n(x)\,dx$,, $\int x^n \sin(x)\,dx$, $\int x^n \cos(x)\,dx$, $\int x^n e^{ax}\,dx$ (Derivations and related problems along with definite limits cases).

References.

1. Theory of Matrices. *B S Vatsa*, New Age International Publishers.
2. Matrices, *A R Vasista*, Krishna Prakashana Mandir.
3. University Algebra, *N.S. Gopala Krishnan*, New Age International (P) Lim- ited.

4. Algebra, *Natarajan, Manicavasagam Pillay and Ganapathy.*

5. Calculus, *Lipman Bers, Holt, Rinehart & Winston.*

6. Schaum's Outline of Calculus, *Frank Ayres and Elliott Mendelson*, 5th ed. USA:Mc. Graw Hill, 2008.

7. Integral Calculus, *Shanthinarayan*, New Delhi: S. Chand and Co. Pvt. Ltd.

8. Integral Calculus, *Shanthinarayan and P K Mittal*, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.

9. Text Book of B.Sc. Mathematics, *G K Ranganath*, S Chand & Company.

Semester II
PRACTICAL 1: ALGEBRA II AND CALCULUS II
(2 Hours/Week per Batch of not more than 19 Students)
Mathematics Practical with FOSS tools for Computer Programs

Suggested Software: Maxima/Scilab/Python/Maple/Matlab/Mathematica/R. At least two programs from each unit should be taught. A total of 10 programs should be taught.

Programs:

Unit 1:

1. Finding minor and co-factor.
2. Programs on echelon form
3. Verifying consistency and solving system of linear equations.
4. Cayley Hamilton theorem verification and related problems.

Unit 2:

1. Verification of Rolle's theorem and mean value theorems (at least two programs).
2. Porgrams on increasing and decreasing functions; concavity and convexity (at least two).

Unit 3:

1. Finding partial derivatives.
2. Verification of homogeneous functions, Euler's theorem and Euler's extension theorem.
3. Problems on Jacobian and its standard properties.
4. Problems on Taylor's & Maclaurin's series for functions of two variables.
5. Problems on definite integral as a limit of a sum.
6. Verification of Fundamental theorem of calculus.
7. Problems on different techniques of integration (with & without using single line command).
8. Verification of Reduction formula.

University of Mysore

Bachelor of Science (B.Sc.)
Curriculum Structure for undergraduate
Mathematics - III and IV Semester (from 2024-25 onward)

Sem	Sl. No	Code	Title of the Paper	Teaching Hours/ Week	Credit Pattern L:T:P	Credit Value	Marks (Weightage)		
							C1	C2	C3
III	1	DSC-MAT-03	Differential calculus – I & Numerical Analysis – I	3–4	3:0:2	5	10%	10%	80%
	2	DSET-MAT 03A	Numerical Analysis II	3	3:0:0	3	10%	10%	80%
	3	DSET – MAT 03B	Calculus IV	3	3:0:0	3	10%	10%	80%
IV	1	DSC-MAT-04	Algebra III & Calculus III	3–4	3:0:2	5	10%	10%	80%
	2	DSET-MAT-04	Real Analysis I & Number Theory	3	3:0:2	3	10%	10%	80%
	3	DSEP-MAT-04	Introduction to LaTeX	4	0:0:2	2	10%	10%	80%

Assessment pattern for theory

Assessments broadly comprise of two components names formative and summative which should be in the proportion 20%:80%.

1. **Formative or Internal Assessments.** This should comprise of two components namely C_1 and C_2. Each of C_1 and C_2 should carry equal weights. Assuming that the theory paper is for 100 marks, the splits are as follows:

(a) C_1 **Component.** A test must be conducted for 10 marks in the eighth week.

(b) C_2 **component.** Any of the assessments such as seminar/assignment/quiz can be conducted for 10 marks or a test can be conducted for 10 marks.

2. **Summative assessment.** This may be named as C_3 component and this should be conducted for 80 marks. The question paper pattern should be as follows:

PART - A

1. **Question 1.** Answering 10 questions out of 12 questions each carrying 2 marks. (Total 20 marks) and four questions from each of the unit should be given.

PART-B

2. **Question 2.** (Answer any two. From unit 1 and carries 10 marks)
    1. (5 marks)
    2. (5 marks)
    3. (5 marks)

PART -C

3. **Question 3.** (Answer any two. From Unit 2 and carries 10 marks)
    1. (5 marks)
    2. (5 marks)
    3. (5 marks)

Part - D

4. **Question 4.** (Answer any two. From Unit 3 and carries 10 marks)
    1. (5 marks)

2. (5 marks)
3. (5 marks)

PART E

5. **Question 5.** Answering 6 out of 9 question each carrying 5 marks (Total 30 marks) and three questions from each of the unit should be given.

Assessment pattern for Practical

Assessment comprises of two components namely formative and summative which should be in the proportion of 20%-80%. Assuming it is for 50 marks, the split should be as follows:

(a) **Formative or internal Assessments:** This should be for 10 marks and should comprise of two components namely C_1 and C_2 and each should carry same weight.

(i) C_1 **Component.** A test should be conducted for 5 marks in the eighth week

(ii) Assignment comprising of two programs of his/her own apart from the programs prescribed in the lab manual (if any) has to be submitted for 05 marks in the fifteenth week.

(b) **Summative assessment.** This may be named as C_3 component and this should be an examination conducted for 40 marks of 3 hours duration. Practical record and viva voce should be evaluated for 5 marks each. A written examination of executing programs for remaining 30 marks should be conducted. The question paper pattern should be as follows:

Question. Answering 3 out of 4 questions each carrying 10 marks (Total 30 marks). Programs from each unit should be given.

SYLLABUS

Semester - III
CORE PAPER
Differential Equations - I & Numerical Analysis - I
Code - DSC-MAT-03

Unit 1 - Introduction to Differential equations **16 Hours**

Differential Equations - Recapitulation of basics of differential equations.
Solutions to differential equations of first order - Classical techniques - Variable separable, reducible to variable separable, Homogeneous, reducible to homogeneous, Exact, reducible to exact (by determining integrating factors), Linear differential equations, Bernouli differential equations;.
Equations of First order and higher degree – Solvable for p, Solvable for x, Solvable y, Clairaut's equations – Singular and General solutions.

Unit 2 - Numerical Methods & Differential equations of highre order **16 Hours**

Brief discussion on the significance of numerical techniques: **Error analysis** - Significant digits, absolute , relative, percentage errors, rounding off and truncation errors, general error formula, error in series approximation, Taylor series approximation.
Numerical techniques for solving differential equations - Euler's method, Euler's modified method, Runge Kutta fourth order method, Picard's method.

Ordinary Linear differential equations with constant coefficients - Complementary function - particular integral - inverse differential operators.

Unit 3 - Second Order Differential equations **16 Hours**

Cauchy-Euler differential equations - Solutions of ordinary second order linear differential equations with variable coefficients - Methods:

1. When a part of complementary function is given

2. Changing the independent variable

3. Changing the dependent variable

4. By the method of variation of parameters

5. Exact Method

Total differential equations - Necessary and sufficient condition for the equation $Pdx + Qdy + Rdz = 0$ to be exact (proof only for the necessary part) – Simultaneous equations of the form $\frac{dx}{P} = \frac{dx}{Q} = \frac{dz}{R}$.

References:

1. G. F. Simmons, *Differential equations with applications and historical notes*, McGraw Hill Education; 2nd edition.

2. E. Kreyszig, *Advances Engineering Mathematics*, John Wiley & Sons Inc; 10th edition.

3. M D Raisinghania, *Ordinary and partial differential equations*, S. Chand Publications, 20th Edition.

4. D. A. Murray, *Introductory Course in Differential Equations*, Khosla publications.

5. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers

6. E.Isaacson and H.B.Keller, Analysis of Numerical methods, Dover Publications.

7. S.S. Sastry, *Introductory methods of Numerical Analysis*, 5thEdition, PHI Learning Private Limited.

8. B.S. Grewal, *Numerical Methods for Scientists and Engineers*, Khanna Publishers.

9. B.D.Gupta, *Numerical Analysis*, Konark Publishers Pvt.Ltd.

10. S.R.K. Iyengar and R.K. Jain, *Numerical methods*, New Age International Pvt. Ltd

Semester III
PRACTICAL 1: DIFFERENTIAL EQUATIONS I & NUMERICAL ANALYSIS I
(4 hours /Week per batch of not more than 19 students)

Mathematics practical with FOSS tools for computer programs

Suggested software: Maxima/Scilab/Python/Maple/Matlab/Mathematica/R. A minimum of 10 programs should be taught.

Programs:

1. Programs on differential equations such as:
   (a) Solving differential equations of first and higher orders (with at least three different programs).
   (b) Verifying exactness (in the cases applicable)
   (c) Finding the wronskian.
   (d) Finding parts of complementary functions
2. Programs on numerical analysis such as:
   (a) Solving equations through bisection/Newton-Raphson/Regula Falsi (three different programs)
   (b) Solving system of linear equations (at least two different methods)
   (c) Solving differential equations through Runge-Kutta method/Picard's method etc. (at least)
   (d) On Newton-Gregory formulas and Numerical differentiation and integration.

ELECTIVES

Elective: DSET - MAT - 03A
Numerical Analysis II

Unit 1 - Solutions to system of equations **16 Hours**

Solutions to algebraic and transcendental equations - Bisection method, Regula-Falsi method, iterative method Newton-Raphson method and secant method (Brief discussion of the rationale behind techniques and problems on their applications).
System of Linear Algebraic Equations - Direct Methods– Gauss elimination method, Gauss-Jordan elimination method and Tringularization method; Iterative methods – Jacobi method, Gauss-Jacobi method, Gauss- Seidal method,Successive- Over Relaxation method(SOR) method.

Unit 2 - Polynomial interpolations **16 Hours**

Finite differences - Forward, backward and central differences and shift operators: definitions, properties and problems; Polynomial interpolation - Newton-Gregory forward and backward interpolation formulas, Gauss's Forward and backward interpolation formulas, Lagrange interpolation polynomial, Newton's divided differences and Newton's general interpolation formula (Discussion on setting up the polynomials, differences between them and problems on their applications).

Unit 3 - Numerical differentiation and integration **16 Hours**

Formula for derivatives (till second order) based on Newton-Gregory forward and backward interpolations (Derivations and problems based on them). Numerical Integration- General quadrature formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule and Weddell's rule (derivations for only general quadrature formula, trapezoidal rule and Simpson's 1/3rd rule and problems on the applications of all formulas).

References:

1. E.Isaacson and H.B.Keller, *Analysis of Numerical methods*, Dover Publications.

2. S.S. Sastry, *Introductory methods of Numerical Analysis*, PHI Learning Private Limited, 5th Edition.

3. E Kreyszig, *Advanced Engineering Mathematics*, Wiley India Pvt.Limited

4. B.S. Grewal, *Numerical Methods for Scientists and Engineers*, Khanna Publishers.

5. M.K.Jain, S.R.K. Iyengar and R.K.Jain, *Numerical Methods for Scientific and Engineering computation*, New Age International, 4th Edition.

6. H.C.Saxena, *Finite Difference and Numerical Analysis*, S.Chand Publishers

7. B.D.Gupta, *Numerical Analysis*, Konark Publishers Pvt.Ltd.

8. S.R.K. Iyengar and R.K. Jain. *Numerical methods*, New Age International Pvt. Ltd

Elective: DSET - MAT - 03B
Advanced Calculus

Unit 1 - Introductory concepts for curve tracing:

Recalling polar coordinates (relation with cartesian coordinates, formula for the angle between the curves & derivatives of arc in polar and cartesian forms. Simple problems), Pedal equations, curvature of plane curves - radius of curvature in polar, parametric and carteisan forms, Pedal equations, center of curvature and circle of curvature, Envelopes and Evolutes (definition and methods of finding envelopes).

Unit 2 - Curve tracing

asymptotes and methods of finding asymptotes; asymptotes parallel to coordinate axes, Procedure of tracing of cartesian curves (such as - $y^2(a-x) = x^2(a+x)$, $y = x^3/(a-x)$, $y^2(a^2+x^2) = x^2(a^2-x^2)$).

Unit 3 - Vector Calculus

Vectors – Scalars – Vector Field – Scalar field (definition and problems); Vector differentiation – The vector differential operator, Gradient – Divergence

– Curl – Standard derivations – vector integration - Green's theorem in plane (definition and problems).

References:

1. M. R. Spiegel. *Theory and problems of vector calculus*, McGraw-Hill Inc., US
2. Shanthinarayan and J N Kapur, *A text book of Vector calculus*, S. Chand Publications.
3. K. S. Chandrashekhar. *Engineering Mathematics II*. Sudha Publications.
4. H. S. Dhami, *Differential Calculus*, New Age International Pvt Ltd Publishers

Semester - IV
CORE PAPER
Algebra III & Calculus III
Code - DSC-MAT-04

Unit 1 - Introduction to Number theory and Group theory **16 Hours**

Division algorithm, Divisibility, Prime and composite numbers, Greatest Common divisor(GCD), co-primes (definition & Properties), Eucledian algorithm for finding the GCD. Fundamental theorem of arithmetic, Congruences (definition, properties & problems on finding remainders), Euler's Φ function(only definition), Wilson's theorem, Euler's theorem and Fermat's little theorem(only statements, no problems).

Introduction to Group Theory: Definition and examples of groups; some general properties of groups; Groups of permutations - Cyclic permutations, even-odd permutations;

Unit 2 - Subgroups and homomorphism **16 Hours**

Subgroups; Cyclic subgroups, Properties of cyclic subgroups; Cosets, Index of a group, Lagrange's theorem, consequences, Normal subgruops, Quotient groups; Homomorphisms - Kernel of homomorphism, Isomorphism, Automorphism, Fundamental theorem of homomorphism; Cayley's theorem.

Unit 3 - Line and Multiple integrals **16 Hours**

Line integral: Definition of line integral and basic properties, examples on evaluation of line integrals. Double integral: Definition of Double integrals and its conversion to iterated integrals. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas using double integrals. Triple integral: Definition of triple integrals and evaluation- change of variables, volume as triple integral.

References:

1. I.N. Herstein, *Topics in Algebra*. Wiley publications, 2nd edition.

2. Joseph Gallian, *Contemporary Abstract Algebra*, Narosa Publishing House, New Delhi, Fourth Edition.

3. J. B. Fraleigh, *A first course in abstract algebra*, Pearson Education India; 7th edition

4. M. Artin, *Algebra*, PHI Learning Pvt. Ltd., New Delhi, India, 2nd edition.

5. Vashista, *A First Course in Modern Algebra*, Krishna Prakasan Mandir,11th edition.

6. R Balakrishan and N.Ramabadran, A Textbook of Modern Algebra, Vikas publishing house pvt. Ltd, New Delhi, India, 1st edition.

7. D. M Burton, *Elementary Number Theory*, McCraw Hill. 6th edition.

8. Emil Grosswald, *Topics from the Theory of Numbers*, Modern Birhauser.

9. I. Niven, H. S. Zuckerman and H. L. Montgomery, *An Introduction to the Theory of Numbers*, John Willey (New York).

Semester IV

PRACTICAL 1: ALGEBRA III & CALCULUS III

(4 hours /Week per batch of not more than 19 students)

Mathematics practical with FOSS tools for computer programs

Suggested software: Maxima/Scilab/Python/Maple/Matlab/Mathematica/R. A Minimum of 10 programs should be taught.

Programs:

1. Programs in number theory (anything within the scope of the theory syllabus - at least four programs).

2. Programs in group theory such as:

   (a) Verifying the laws such as commutative, associative, closure etc. (at least three programs)

   (b) Constructing Cayley's table.

   (c) Finding the identity element and inverses. (Two programs)

(d) Finding if a subgroup is cyclic/normal or not. (Two programs)

(e) Constructing the cosets of a given subgroup.

(f) Programs on homomoprhisms.

Compulsory (Practical Knowledge / Skill)

DSEP - MAT - 04

Basics of LaTeX typesetting/Microsoft Equation Editor 3.0

For Latex typesetting: Overall focus should be on -

1. A brief introduction to LaTeX language and difference between LaTeX and word.
2. Installation of MikeTex
3. Installation of platforms TeX Studio/TeXmaker/WinEdt
4. Uses of learning LaTeX.

Following typesetting skills should be mainly focused:

1. Writing preamble and the knowledge of packages & document classes required.
2. Basics of typesetting - Basic alignment/paragraph writing/line spacing/word spacing/margin/font coloring/font size/font style
3. Mathematical Typesetting - Mathematical Typesetting - Basic symbols/commands for mathematical typesetting - packages required; Typesetting of various symbols, matrices, vectors etc.
4. Environments - Various environments - center, equation, align, multline, labelling equations.
5. Tables - Creation of table (various kinds), naming the tables, alignments.
6. Boxes - Creation of text box, color textbox, minipage, Inserting image
7. Sectioning - Creation of sections, subsections, susbsubsections and naming the equations, definitions etc. as per the section.

8. Image insertion
9. Introduction to beamer class (preparation of presentations)
10. Introduction to overleaf

LaTeX learning platforms:

1. www.overleaf.com (www.oberleaf.com/learn/latex/Learn_LaTeX_in_30_minutes)
2. *The very short guide to typesetting with LaTeX* (bu.edu/math/files/2013/08/ShortTex3.pdf)
3. *LaTeX Tutorials - A Primer* (tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf)
4. Stefan Kottwitz, *LaTeX Beginner's Guide* (static.latexstudio.net/wp-content/uploads/2015/03/LaTeX_Beginners_Guide.pdf)

For Microsoft Equation Editor 3.0, Points 2 to 8 in the above mentioned list should be focused.

ELECTIVES

Elective: DSET - MAT - 04
Real Analysis & Number Theory

Unit 1 - Riemann Integration 1 — 16 hours

Introduction to sequence of numbers (definition). Meaning of convergence, divergence and limit of a sequence (Mentioning of $\epsilon - N$ definition but more focus on intuition & visualization), properties of limits (only mention), limits of some standard sequences such as $\frac{1}{n}$, $\left(1+\frac{1}{n}\right)^n$, $n^{\frac{1}{n}}$ and x^n (only mention), evaluation of simple limits.
Definition and examples for partition of an interval, Refinement and common refinement of a partition; Lower and upper Riemann (Darboux) sums - Definition, properties and problems; Riemann integral - Lower and Upper integrals (definition and problems), Darboux's theorem and criterion for integrability, integrability of sum, difference, product, quotient and modulus of integrable functions. Problems on integrability verification.

Unit 2 - Improper Integrals **16 Hours**

Improper Integrals (definition only) – Gamma and Beta functions and results following the definitions – Connection between Beta and gamma functions – applications of evaluation of integrals – Duplication formula.

Unit 3 - Advanced Number theory **16 Hours**

Recalling congruence; Linear congruence - Criteria for existence of solution with proof. problems; Fermat's little theorem. Euler's theorem and Wilson's theorem (with proof and problems); Pseudo primes and absolute pseudo primes; Simultaneous linear congruence (Chinese remainder theorem - without proof); Introduction to cryptography - coding and decoding based on Caesar's, Vigener's ciphers; Method of Lester Hill (for a block of two).

References:

1. W. Rudin, *Principles of Mathematical Analysis*, McGraw Hill Education, 3rd Edition
2. T. Apostol, *Mathematical Analysis*, Narosa Publishing House (India)
3. Ajit Kumar and S. Kumaresan, *A basic Course in Real Analysis*, Taylor and Francis Group
4. R. R. Goldberg, *Methods of Real Analysis*, Oxford and IBH Publishing
5. S.C. Malik and S. Arora, *Mathematical Analysis*, India: New Age International (India) Pvt. Ltd, 5th Edition
6. S. C. Malik, *Principles of Real Analysis*, New Age Internation (India), Pvt. Limited, 4th Edition.
7. D. M Burton, *Elementary Number Theory*, McGraw Hill, 6th edition.
8. Emil Grosswald, *Topics from the Theory of Numbers*, Modern Birhauser.
9. I. Niven. H. S. Zuckerman and H. L. Montgomery, *An Introduction to the Theory of Numbers*, John Willey (New York).