BENGALURU NORTH UNIVERISTY

B. Sc., MATHEMATICS SYLLABUS

(V & VI Semesters)

With effect from Academic Year 2023-2024

DEPARTMENT OF MATHEMATICS

Bengaluru North University

Tamaka, Near NH 75 in Kolar

KARNATAKA

SEPTEMBER - 2023

BENGALURU NORTH UNIVERSITY
Department of Mathematics

Date: 08-09-2023

PROCEEDING OF THE BOS (UG) MATHEMATICS

The meeting of the Board of Studies in UG Mathematics for the year 2023-24 was held on Friday, **8th September 2023** at 11.00am in the Department of Mathematics, GFGC, K R Puram, Bangalore North University, Bangalore. The following members attended the meeting:

Sl. No.	Name	Signature
1	Dr. B. Chaluvaraju, Chairman	
2	Prof. Nagaraddi B. Y. , Member	
3	Smt. Mariya Khibthiya, Member	
4	Dr. Kemparaju S., Member	
5	Smt. Suguna H. G., Member	
6	Dr. Bhargavi P., Member	
7	Dr. M. C. Mahesh Kumar, Member	
8	Dr. Radhika M., Member	
9	Dr. Srinivas Rao, Member	
10	Mr. Hanumantha Reddy D. T. , Member	
11	Dr. Veeranna, Member	

Agenda and Resolution:

1. Final draft of the **UG-Mathematics (V & VI Semester B. Sc.,)** was checked and discussion held. The suggestions given by the BOS members and subject experts were incorporated.
2. The syllabus framed as per UGC and KSHEC guidelines. The syllabus prepared by teachers with a Mathematics practical component, by using Free and Open Source Software (FOSS) packages. The BOS also resolved to change the list of practical experiments each year. Finally, the syllabus was approved by all the members.
3. The committee approved the updated panel of examiners for UG (Mathematics).

The Chairman thanked the members for their cooperation.

08/09/2023

[Dr. B. CHALUVARAJU]
CHAIRMAN
BNU-BOS in UG-Mathematics

Dr. B. CHALUVARAJU
M.Sc., Ph.D
Professor
Department of Mathematics
Bangalore University, Jnanabharathi
BENGALURU - 560 056.

Copy to:

1. The Registrar, Bengaluru North University, Bengaluru
2. The PS to the Vice-Chancellor, Bengaluru North University, Bengaluru

MISSION AND VISION OF THE NEW SYLLABUS IN MATHEMATICS

Mission

- Improve retention of mathematical concepts in the student. Also, develop a spirit of inquiry in the student.
- To improve the perspective of students on mathematics as per modern requirement.
- To initiate students to enjoy mathematics, pose and solve meaningful problems, to use abstraction to perceive relationships and structure and to understand the basic structure of mathematics.
- To enable the teacher to demonstrate, explain and reinforce abstract mathematical ideas by using concrete objects, models, charts, graphs, pictures, posters with the help of FOSS tools on a computer.
- To make the learning process student-friendly by having a shift in focus in mathematical teaching, especially in the mathematical learning environment.
- Exploit techno-savvy nature in the student to overcome math-phobia.
- Propagate FOSS (Free and open source software) tools amongst students and teachers as per vision document of National Mission for Education.
- To set up a mathematics laboratory in every college in order to help students in the exploration of mathematical concepts through activities and experimentation.
- To orient students towards relating Mathematics to applications.

Vision

- To remedy Math phobia through authentic learning based on hands-on experience with computers. Also,
- To show that ICT can be a panacea for quality and efficient education when properly integrated and accepted.
- To prove that the activity-centered mathematics laboratory places the student in a problem solving situation and then through self-exploration and discovery habituates the student into providing a solution to the problem based on his or her experience, needs, and interests.
- To provide greater scope for individual participation in the process of learning and becoming autonomous learners. Also, provide scope for greater involvement of both the mind and the hand which facilitates cognition?
- To ultimately see that the learning of mathematics becomes more alive, vibrant, relevant and meaningful; a program that paves the way to seek and understand the world around them. A possible by-product of such an exercise is that math-phobia can be gradually reduced amongst students.
- To help the student build interest and confidence in learning the subject.

Support system for Students and Teachers in understanding and learning FOSS TOOLS:

As a national level initiative towards learning FOSS tools, IIT Bombay for MHRD, Government of India is giving free training to teachers interested in learning open source software's like scilab, maxima, python, octave, geogebra and others.

(Website: http://spoken-tutorial.org ; email: contact@spoken-tutorial.org ; info@spokentutorial.org)

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Name of the Degree Program : **B.Sc.**

Discipline Course : **Mathematics**

Starting Year of Implementation : **2021-22 (I & II Semesters)**
2022-23 (III & IV Semesters)
2023-24 (V & VI Semesters)

Programme Outcomes (PO) : **By the end of the program the students will be able to**

PO 1	**Disciplinary Knowledge**: Bachelor degree in Mathematics is the culmination of in-depth knowledge of Algebra, Calculus, Geometry, differential equations and several other branches of pure and applied mathematics. This also leads to study the related areas such as computer science and other allied subjects.
PO 2	**Communication Skills**: Ability to communicate various mathematical concepts effectively using examples and their geometrical visualization. The skills and knowledge gained in this program will lead to the proficiency in analytical reasoning which can be used for modeling and solving of real life problems.
PO 3	**Critical thinking and analytical reasoning:** The students undergoing this programme acquire ability of critical thinking and logical reasoning and capability of recognizing and distinguishing the various aspects of real life problems.
PO 4	**Problem Solving**: The Mathematical knowledge gained by the students through this programme develop an ability to analyze the problems, identify and define appropriate computing requirements for its solutions. This programme enhances students overall development and also equip them with mathematical modelling ability, problem solving skills.

PO 5	**Research related skills:** The completing this programme develop the capability of inquiring about appropriate questions relating to the Mathematical concepts in different areas of Mathematics.
PO 6	**Information/digital Literacy**: The completion of this programme will enable the learner to use appropriate softwares to solve system of algebraic equation and differential equations.
PO 7	**Self – directed learning**: The student completing this program will develop an ability of working independently and to make an in-depth study of various notions of Mathematics.
PO 8	**Moral and ethical awareness/reasoning:** The student completing this program will develop an ability to identify unethical behavior such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and Mathematical studies in particular.
PO 9	**Lifelong learning**: This programme provides self directed learning and lifelong learning skills. This programme helps the learner to think independently and develop algorithms and computational skills for solving real word problems.
PO 10	Ability to peruse advanced studies and research in pure, applied and computational Mathematical sciences.

ASSESSMENT

Weightage for the Assessments (in percentage)

Type of Course	Formative Assessment (I.A.)	Summative Assessment(S.A.)
Theory	40%	60%
Practical	50%	50 %
Projects	40%	60%
Experiential Learning (Internship etc.)	--	--

CURRICULUM STRUCTURE FOR UNDERGRADUATE DEGREE PROGRAM

Name of the Degree Program : **B.Sc.**

Discipline/Subject : **Mathematics**

Year/Semester : **3rd Year/ V & VI Semester**

Semester	Course No.	Theory/ Practical	Credits	Paper Title	Marks	
					S.A.	I.A.
V	**MATDSCT5.1**	Theory	4	Real Analysis-II and Complex Analysis	**60**	**40**
	MATDSCP5.1	Practical	2	Theory based Practical's on Real Analysis-II and Complex Analysis	**25**	**25**
	MATDSCT5.2	Theory	4	Vector Calculus and Group Theory	**60**	**40**
	MATDSCP5.2	Practical	2	Theory based Practical's on Vector Calculus and Group Theory	**25**	**25**
VI	**MATDSCT6.1**	Theory	4	Ring Theory and Linear Algebra	**60**	**40**
	MATDSCP6.1	Practical	2	Theory based Practical's on Ring Theory and Linear Algebra	**25**	**25**
	MATDSCT6.2	Theory	4	Numerical Analysis	**60**	**40**
	MATDSCP6.2	Practical	2	Theory based Practical's on Numerical Analysis	**25**	**25**

Abbreviation for MATDSCT5.1 / MATDSCP 5.1: MAT – Mathematics; **DSC** – Discipline Core; **T** – Theory /**P** – Practical; **V** – Fifth Semester; **VI** – Sixth Semester.

Syllabus for B.Sc. with Mathematics
SEMESTER–V
(2023-24 onwards)

MATDSCT5.1: Real Analysis-II and Complex Analysis	
Teaching Hours:4Hours/Week	**Credits:4**
Total Teaching Hours:60Hours	**Max.Marks:100 (S.A.-60+I.A.–40)**

Course Learning Outcomes: This course will enable the students to:

- Carry out certain computational methods of an upper and lower Riemann sums as well as integrals.
- Describe various criteria for an upper and lower Integrability of functions.
- Develop a deep understanding of definite and indefinite integrals, beta and gamma functions and their applications
- Study the applications of definite integrals and duplication formula.
- Gain knowledge about the complex number system, the complex function, complex integration and their geometrical representations on the complex plane.
- Memorize Euler's formula and its representation of complex numbers. Also, understanding the concepts of limit, continuity, differentiability and analyticity for complex functions.
- Analyze elementary transformations such as translation, rotation, magnification, and inversion. Also, understanding the concepts of the cross-ratio of four points and conformal mapping.
- Explain the significance of complex variables and their applications in Science and Engineering.

MATDSCT5.1: REAL ANALYSIS-II AND COMPLEX ANALYSIS

Unit–I: Riemann Integration

Definition and examples for partition of an interval, refinement of a partition and common refinement. Riemann Darboux Sums-Upper and lower (Darboux) sum-definition, properties and problems.

Riemann Integral – Upper and Lower integrals (definition & problems), Darboux's theorem and Criterion for Integrability, Integrability of sum, difference, product, quotient, and modulus of integrable functions. Integral as a limit of sum (Riemann sum)-Problems. Some integrable functions Integrability of continuous functions, monotonic functions, bounded function with finite number of discontinuity.

15 Hours

Unit –II: Improper Integrals

Improper Integrals – **Improper** integrals of the first, second and third kind with examples. Improper integral as the limit of the proper integral.

Beta-Gamma Functions – Definitions, Properties and examples, relations between beta and gamma functions, standard theorems, applications of definite integrals, duplication formula and its applications.

15 Hours

Unit – III: Complex numbers and functions of complex variables

Complex numbers-Cartesian and Polar form-Geometrical representation- Complex-Plane-Euler's formula – $e^{i\theta} = Cos\theta + i\, Sin\theta$.

Functions of a Complex variable-limit, Continuity and Differentiability of a Complex function. Analytic function, Cauchy-Riemann equations in Cartesian form with proof and related problems.

Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given-Milne Thomson method.

15 Hours

Unit –IV: Complex Integration and Transformations:

Complex Integration: – Definition, Line integral, properties and problems. Cauchy's Integral theorem-proof using Green's theorem-direct consequences. Cauchy's Integral formula with proof-Cauchy's generalized formula for the derivatives with proof and applications for evaluation of simple line integrals-Cuchy's inequality with proof-Liouville's theorem with proof. Fundamental theorem of algebra with proof.

Transformations: Linear Transformation-Definitions-Bilinear transformations- Cross-ratio of four points-Cross-ratio preserving property-Preservation of the family of straight lines and circles-Conformal Mappings-Discussion of the transformations. $w = \frac{1}{z}$, $w = sinz,\ w = cosz,\ w = e^z$.

15 Hours

REFERENCE BOOKS:

1. S. C. Malik and Savita Arora, Mathematical Analysis, 6th ed.: New Age Intl. Ltd. 2021.
2. Robert G. Bartle and Donald R. Sherbert, Introduction to Real Analysis, , Wiley, 2021.
3. Ajit Kumr and S. Kumaresan, A Basic Course in Real Analysis, Taylor and Francis Group, 2014.
4. N. P. Bali, Real Analysis, Golden Math Series, Laxmi Pub. Pvt. Ltd , New Delhi, 2013.
5. Walter Rudin, Principles of Mathematical Analysis, 3rd Ed. McGraw Hill Ed. 2017.
6. L. V. Ahlfors, Complex Analysis, 3rd, McGraw Hill Education, 1978.
7. Bruce P. Palka, Introduction to the Theory of Function of a Complex Variable, Springer, 2012.
8. Serge Lang, Complex Analysis, 4th ed. Springer, 2003.
9. Shanthi Narayan and M.D. Raisinghania, Elements of Real Analysis, 14th ed. S. Chand Publishers, 2013.
10. Shanthi Narayan and P. K. Mittal, Theory of Functions of a Complex Variable, 2nd ed. S. Chand Publishers, 2005.

11. S. Ponnuswamy, Foundations of Complex Analysis, 2nd ed., Narosa, 2011.
12. J. W. Brown & R. V. Churchil, Complex Variables and Applications, 8th ed, McGraw Hill Companies, 2017.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/

MATDSCP 5.1: PRACTICAL'S ON REAL ANALYSIS-II AND COMPLEX ANALYSIS	
Practical Hours: 4 Hours/Week	**Credits: 2**
Total Practical Hours: 60 Hours	**Max. Marks: 50 (S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open-Source Software (FOSS) tools for computer Programming.
- Solve the problems on the Real Analysis-II and Complex Analysis are studied in **MATDSCT 5.1** b**y** using FOSS software's.
- Acquire knowledge of applications of Real Analysis-II and Complex Analysis through FOSS tool.
- Estimate the General mathematical solution and FOSS tool utilized computational solution of Real Analysis-II and Complex Analysis.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's:
wxMaxima/Scilab /Python/R/Maple/Sage…etc.

Suggested Programs:

1. Fundamental elements of Real Analysis-II and Complex Analysis using FOSS.
2. Program to check whether a given set of real numbers attains supremum or infimum.
3. Program to find upper and lower Riemann sums with respect to given partition
4. Program to test the Riemann Integrability.
5. Program to evaluate Riemann integral as a limit of sum.
6. Evaluation of the integrals using Gamma function.
7. Evaluation of the integrals using Beta function.
8. Verification of Cauchy – Riemann equations (Cartesian form) or test for analyticity.
9. Program to check whether a function is harmonic or not.
10. Program to construct analytic functions (through Milne–Thompson method).
11. Verification of problems on Cauchy's Integral theorem
12. To find the Cross ratio of four points in complex transform.

MATDSCT 5.2: VECTOR CALCULUS AND GROUP THEORY	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Get introduced to the fundamentals of vector differential and integral calculus.
- Get familiar with the various differential operators and their properties.
- Get acquainted with the various techniques of vector integration.
- Learn the applications of vector calculus.
- Understanding the concepts of Variation of a function and Extremal of a function
- Solve the standard problems like geodesics, minimal surface of revolution, hanging chain and Brachistochrone.
- Understand the concepts of Normality, Quotient group and Homomorphism groups.
- Learn the nature of kernel and image of Homomorphism groups. Also, identify the significance of Isomorphism groups.

MATDSCT5.2: Vector Calculus and Group Theory

Unit – I: Vector Algebra

Vector Algebra: Multiple product – scalar triple product, vector triple product, geometrical interpretation, related problems, vector function of a scalar variable – interpretation as a space curve, derivative, tangent, normal and binormal vectors to a space curve.

Scalar field: Gradient of a scalar field, geometrical meaning, directional derivative, unit normal to the surfaces - tangent plane and normal to the surface.

Vector field: Divergence and curl of a vector field, solenoidal and irrotational fields, Laplacian of a scalar field, Vector identities.

15 Hours

Unit – II: Vector Integration

Vector Integration – Definition and basic properties, vector line integral, surface integral and volume integral; **Green's theorem in the plane** – Proof and related problems, **Gauss' Divergence theorem** – Proof and related problems, **Stokes' theorem** – Proof and related problems.

15 Hours

Unit-III: Calculus of Variations

Variation of a function – variation of the corresponding functional – extremal of a functional – variational problem – Euler's equation and its particular forms – Examples – standard problems like geodesics, minimal surface of revolution, hanging chain, Brachistochrone problem –Isoperimetric problems.

15Hours

Unit-IV: Group Theory

Recapitulation of Elements of Group theory (i.e., Groups, subgroups, cyclic groups, cosets). Normal subgroups-examples and problems – Quotient group.

Homomorphism and Isomorphism of groups-Kernel and image of a homomorphism-Normality of the Kernel-Fundamental theorem of homomorphism- properties related to isomorphism-Permutation group-Cayley's theorem.

15 Hours

REFERENCE BOOKS:

1. M. D. Raisinghania, Vector Calculus, S. Chand Co. Pvt.Ltd., 2013.
2. M. Spiegel, Vector Analysis, 2ndEd., Schaum's Outline Series, Mc-Graw Hill Pub. House Edition, 2017.
3. C. E. Weatherburn, Elementary Vector Analysis, Alpha ed., 2019.
4. Shanthi Narayan and P. K. Mittal, Integral Calculus, Reprint. New Delhi: S. Chand and Co. Pvt. Ltd., 2013.
5. B. S. Grewal, Higher Engineering Mathematics, 42nd ed. Khanna Publishers, 2017.
6. A. S. Gupta, Calculus of Variations, Prentice Hall of India, New Delhi, 2011.
7. Oskar Bolza, Lectures on the Calculus of Variations, Dover Pub. New York, 2018.
8. R. K. Sharma, Calculus of Variations, Medtech, 2017.
9. P. N. Wartikar and J. N. Wartikar, A Textbook of Applied Mathematics, Vol. II, Pune Vidyarthi Griha Prakashan, 2008.
10. I. N. Herstein, Topics in Algebra, 4th ed. New Delhi, India: Vikas Publ. House Pvt, Ltd., 1991.
11. B. Boumslag and B. Chandler, Schaum's outline series on groups, 1968.
12. Michael Artin, *Algebra*, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/

MATDSCP5.2: PRACTICAL'S ON VECTOR CALCULUS AND GROUP THEORY	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open-Source Software (FOSS) tools for computer Programming.
- Solve the problems on the Vector Calculus, Calculus of variations and Group Theory are studied in **MATDSCT 5.2** b**y** using FOSS software's.
- Acquire knowledge of applications of the Vector Calculus, Calculus of variations and Group Theory through FOSS tool.
- Estimate the General mathematical solution and FOSS tool utilized computational solution of the Vector Calculus, Calculus of variations and Group Theory.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's:
wxMaxima/Scilab /Python/R/Maple/Sage…etc.

Suggested Programs:

1. Fundamental elements of Vector Calculus, Calculus of variations and Group Theory using FOSS tool.
2. Program to verify the multiple products of vectors – Scalar and Cross product.
3. Program to verify y the vector differentiation and finding unit tangent.
4. Program to find the gradient and Laplacian of a scalar function.
5. Program to find the divergence and curl of a vector function.
6. Program to evaluate a vector line integral, a surface integral and a volume integral.
7. Program to verify Green's theorem, the Gauss' Divergence theorem and the Stokes' theorem.
8. Examples on Euler's equation in particular form and full form.
9. Examples on minimum surface of revolution, Brachistochrone problem and Isoperimetric problems.
10. Program to verify whether given set is a group with respect to binary operations, find an identity and inverse elements of a group, and find the index of a subgroup of a group.
11. Program to verification of normality of a given subgroup.
12. Examples on homomorphism and isomorphism of groups.

SEMESTER–VI
(2023-24 onwards)

MATDSCT 6.1: RING THEORY AND LINEAR ALGEBRA	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Understand the concepts of Rings, subrings and Ideals and their properties.
- Get familiar with nature of special types of ideals such as Principal, Prime and Maximal ideals.
- Comparing among rings, integral domain, quotient ring and field.
- Understand the concepts of every field is an integral domain, every finite integral domain is a field with examples.
- Understand the concepts of Vector spaces, subspaces, linear combination, linear dependence, linear independence, bases and dimension.
- Solve the linear combination, linear dependence, linear independence and bases related problems.
- Become familiar with the concepts Vector space homomorphism and its basic properties.
- Understand the concepts of Eigen values, eigen vectors and linear transformations and their basic properties.

MATDSCT 6.1: Ring Theory and Linear Algebra

Unit I: Ring Theory

Definition and examples of rings, properties of rings, subrings, necessary and sufficient condition for a nonempty subset of a ring to be a subring, integral domains and fields, subfield. Ideal, ideal generate by a subset of a ring, factor rings, operations on ideals, principal, prime and maximal ideals. Ring homomorphisms, properties of ring homomorphisms. Ring isomorphism and its properties.

15 Hours

Unit – II: Vector Spaces

Vector Spaces: Definition, example and properties of vector space.

Subspaces: Examples, criterion for a sub- set to be a subspace and some properties.

Basis and dimension: Linear Combination-Linear span, Linear dependence and Linear independence, basic properties of linear dependence and independence, techniques of determining linear dependence and independence in various vector spaces and related

problems. Co-ordinates, ordered basis, some basic properties of basis and dimension and subspace spanned by given set of vectors.

15 Hours

Unit–III: Linear Transformations

Definition, examples, equivalent criteria, some basic properties, and matrix representation and change of basis and effect on associated matrix, similar matrices. Null space, Range space, proof of Rank– Nullity theorem and related problems.

15 Hours

Unit–IV: Isomorphism, Eigen values and Eigen vectors.

Isomorphism and Automorphism: Examples, order of automorphism and Fundamental theorem of homomorphism.

Eigen values and Eigen vectors: Computation of Eigen values, algebraic multiplicity, some basic properties of eigenvalues, determination of eigen vectors and eigen space and geometric multiplicity.

15 Hours

REFERENCE BOOKS:

1. I. N. Herstein, Topics in Algebra, 4th Ed. New Delhi, India: Vikas Publ. House Pvt, Ltd., 1991.
2. A. R. Vasishtha, Modern Algebra, 16th Ed., Krishna Prakshan Mandir, 2010.
3. Stephen H. Friedberg, Arnold J. Insel & Lawrence E. Spence, Linear Algebra. 4th Ed., Prentice-Hall of India Pvt. Ltd, 2003.
4. Kenneth Hoffman & Ray Kunze, Linear Algebra, 2nd Ed., Prentice Hall India Leaning Private Ltd., 2015.
5. Gilbert Strang, Linear Algebra and its applications, 2nd ed., Elsevier, 2015.
6. Vivek Sahai & Vikas Bist, Linear Algebra, 2nd Ed., Narosa Publishing House, 2013.
7. Serge Lang, Introduction to Linear Algebra (2nd ed.), Springer India, 2005.
8. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
9. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
10. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/

MATDSCP 6.1: PRACTICAL'S ON RING THEORY AND LINEAR ALGEBRA	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60 Hours	**Max. Marks: 50 (S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open-Source Software (FOSS) tools for computer Programming.
- Solve the problems on the MATDSCT 6.1: Ring Theory and Linear Algebra are studied in **MATDSCT 6.1 by** using FOSS software's.
- Acquire knowledge of applications of the Ring Theory and Linear Algebra through FOSS tool.
- Estimate the General mathematical solution and FOSS tool utilized computational solution of the Ring Theory and Linear Algebra.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's:
wxMaxima/Scilab /Python/R/Maple/Sage…etc.

Suggested Programs:

1. Fundamental elements of Ring Theory and Linear Algebra using FOSS tool.
2. Program to verify the illustrative examples on different types of rings.
3. Program to verify the illustrative examples on integral domains and fields.
4. Program to verify the illustrative examples on subrings, ideals and subrings, which are not ideals.
5. Program to verify the illustrative examples on Homomorphism and isomorphism of rings.
6. Program to verify the illustrative examples on vector space and subspace.
7. Program to determine the linear combination, linear dependence and linear independence in various vector spaces and related problems.
8. Program to find basis and dimension of the subspaces.
9. Program to verify whether a function is a linear transformation or not.
10. Program to verify the illustrative examples on Rank – nullity theorem.
11. Program to find the matrix of linear transformation.
12. Program to find the Eigenvalues and Eigenvectors of a given linear transformation.

MATDSCT 6.2: NUMERICAL ANALYSIS	
Teaching Hours: 4 Hours/Week	**Credits: 4**
Total Teaching Hours: 60 Hours	**Max. Marks: 100 (S.A.-60 + I.A. – 40)**

Course Learning Outcomes: This course will enable the students to

- Understand the concepts of Algebraic and transcendental equations.
- Solve the system of linear algebraic equations applying both direct and iterative methods. Also know how to solve polynomial interpolation, Numerical Differentiation and Integration.
- Describe various operators arising in numerical analysis such as difference operators, shift operators and so on.
- Articulate the rationale behind various techniques of numerical analysis such as in finding roots, integrals, and derivatives.
- Reproduce the existing algorithms for various tasks as mentioned previously in numerical analysis.
- Apply the rules of calculus and other areas of mathematics in justifying the techniques of numerical analysis.
- Solve problems using suitable numerical technique.
- Appreciate the profound applicability of techniques of numerical analysis in solving real life problems and appreciate the way the techniques are modified to improve the accuracy.

MATDSCT 6.2: Numerical Analysis

Unit – I: Algebraic and Transcendental Equations

Errors: Significant digits, absolute, relative, percentage errors, rounding off and truncation errors (meanings and related problems), general error formula (derivation of formula and problems based on it), error in series approximation, Taylor series approximations (problems only).

Solutions to algebraic and transcendental equations: Bisection method, Secant method, Regula-Falsi method, Newton-Raphson method and Fixedpoint iterative method (Plain discussion of the rationale behind techniques and problems on their applications).

15 Hours

Unit – II: System of Linear Algebraic Equations

Direct Methods: Gauss elimination method, Gauss-Jordan elimination method and LU-Decomposition method.

Iterative Methods: Jacobi method, Gauss-Seidal method, Successive- Over Relaxation (SOR) method.

15 Hours

Unit–III: Polynomial Interpolation

Finite Differences: Forward, backward 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 formula, Newton's divided differences and Newton's general interpolation formula (Discussion on setting up the polynomials, differences between them and problems on its applications).

15 Hours

Unit-IV: Numerical Differentiation and Integration

Numerical Differentiation:- 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, Weddle's rule and problems. (Derivations for only general quadrature formula, trapezoidal rule and Simpson's1/3rd rule and problems on all the formulas).

15 Hours

REFERENCE BOOKS:

1. E. Isaacson and H. B. Keller, Analysis of Numerical methods, revised ed. Dover Publications, 2012.
2. S. S. Sastry, Introductory methods of Numerical Analysis, 5th Edition, PHI Learning Private Limited, 2012.
3. E. Kreyszig, Advanced Engineering Mathematics, 10th ed. Wiley India Pvt. Limited, 2015.
4. B. S. Grewal, Numerical Methods for Scientists and Engineers with Programs in C, C++ & MATLAB,11th ed. Khanna Publishers, 2013.
5. M. K. Jain, S.R.K. Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering computation,4th Edition, New Age International, 2005.
6. S. R. K. Iyengar and R. K. Jain, Numerical Methods: Problems and Solutions, 3rd Edition, New Age International, 2020.
7. H.C. Saxena, Finite Difference and Numerical Analysis, S. Chand Publishers, 2010.
8. B. D. Gupta, Numerical Analysis, Konark Publishers Pvt. Ltd, 1990.
9. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Ed. India, 2007.
10. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/

MATDSCP 6.2: PRACTICAL'S ON NUMERICAL ANALYSIS	
Teaching Hours: 4 Hours/Week	**Credits: 2**
Total Teaching Hours: 60 Hours	**Max. Marks: 50** **(S.A.-25 + I.A. – 25)**

Course Learning Outcomes: This course will enable the students to

- Learn Free and Open-Source Software (FOSS) tools for computer Programming.
- Solve the problems on the MATDSCT 6.2: Numerical Analysis is studied in **MATDSCT 6.2 by** using FOSS software's.
- Acquire knowledge of applications of the Numerical Analysis through FOSS tool.
- Estimate the General mathematical solution and FOSS tool utilized computational solution of the Numerical Analysis.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's:
wxMaxima/Scilab /Python/R/Maple/Sage…etc.

Suggested Programs:

1. Fundamental elements of Numerical Analysis using FOSS tool.
2. Program to find root of an equation using bisection and Regula-Falsi methods.
3. Program to find root of an equation using Newton-Raphson and Secant methods.
4. Program to solve system of algebraic equations using Gauss-elimination method.
5. Program to solve system of algebraic equations using Gauss-Jordan method.
6. Program to solve system of algebraic equation using Gauss-Jacobi method.
7. Program to solve system of algebraic equation using Gauss-Seidel method.
8. Program to solve the system of algebraic equations using SOR method.
9. Program to evaluate integral using Trapezoidal rules.
10. Program to evaluate integral using Weddle rules.
11. Program to evaluate integral using Simpson's 1/3rd rules and Simpson's 3/8th rules.
12. Program to find differentiation at specified point using Newton-Gregory interpolation method.

FORMAT OF THEORY EXAMINATION QUESTION PAPER OF V SEMESTER (MATDSCT 5.1 & MATDSCT 5.2) AND VI SEMESTER (MATDSCT 6.1 & MATDSCT 6.2)

FORMAT OF THEORY EXAMINATION QUESTION PAPER

Question No	Topic	No. of sub divisions		Marks for each sub divisions	Maximum marks for the question
		To be Set	To be answered		
I	UNIT-1	2	6	2	12
	UNIT-2	2			
	UNIT-3	2			
	UNIT-4	2			
II	UNIT-1	5	3	4	12
III	UNIT-2	5	3	4	12
IV	UNIT-3	5	3	4	12
V	UNIT-4	5	3	4	12
Total Theory Examination (Maximum Marks for the paper)					60
Internal Assessment (IA) Marks					40
GRAND TOTAL					**100**

FORMAT OF PRACTICAL EXAMINATION QUESTION PAPER OF V SEMESTER (MATDSCP 5.1 & MATDSCP 5.2) AND VI SEMESTER (MATDSCP 6.1 & MATDSCP 6.2)

FORMAT OF PRACTICAL EXAMINATION QUESTION PAPER

Question no.	Topic	No. of sub divisions		Marks for each sub divisions	Maximum marks for the question
		To be Set	To be answered		
I	UNIT-1	2	1	5	5
II	UNIT-2	2	1	5	5
III	UNIT-3	2	1	5	5
IV	UNIT-4	2	1	5	5
				Record	5
				Total Marks on Practical Examinations	**25**
				Internal Assessment (IA) Marks	**25**
				GRAND TOTAL	**50**

NOTE: Distribution of marks for manual work and execution will be done proportionately.