KUVEMPU UNIVERSITY

SYLLABUS

V and VI Semester
B.A./B.Sc., Mathematics
(According to National Education Policy 2020)

DEPARTMENT OF MATHEMATICS,
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2023-24

Name of the Degree Programm : B.A/B.Sc.,
Discipline course : Mathematics
Starting Year of Implementation : 2021-22 (I & II Semester)
: 2022-23 (III & IV Semester)
: 2023-24 (V & VI Semester)

SEMESTER V

Category	Course Code	Title of the Paper	Marks			Teaching Hours/ Week		Credit	Duration of exams (Hours)
			IA	SA	Total	T	P		
DSC	MATDSCT 5.1	Real Analysis-II and Complex Analysis	40	60	100	4	-	4	2
	MATDSCP 5.1	Theory-based Practical on Real Analysis-II and Complex Analysis	25	25	50	-	4	2	3
	MATDSCT 5.2	Advanced Algebra and Vector Calculus	40	60	100	4	-	4	2
	MATDSCP 5.2	Theory-based Practical's on Advanced Algebra and Vector Calculus	25	25	50	-	4	2	3
SEC-4	-	Employability Skills/ Cyber Security	25	25	50	2	2	3	1

SEMESTER VI									
Category	**Course Code**	**Title of the Paper**	**Marks**			**Teaching Hours/ Week**		**Credit**	**Duration of exams (Hours)**
			IA	**SA**	**Total**	**T**	**P**		
DSC	MATDSCT 6.1	Linear Algebra and Fourier Series	40	60	100	4	-	4	2
	MATDSCP 6.1	Theory-based Practical on Linear Algebra and Fourier Series	25	25	50	-	4	2	3
	MATDSCT 6.2	Numerical Analysis	40	60	100	4	-	4	2
	MATDSCP 6.2	Theory-based Practical on Numerical Analysis	25	25	50	-	4	2	3
SEC-4	-	Internship	-	-	-	-	-	2	-

Syllabus for B.A./B.Sc. with Mathematics
SEMESTER – V

MATDSCT5.1 : Real Analysis-II and Complex 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:

The overall expectation from this course is that the student builds a basic understanding on Riemann integration and elementary complex analysis. The broader course outcomes are listed as follow. At the end of this course, the student will be able to:

1. Carry out certain computations such as computing upper and lower Riemann sums as well as integrals.
2. Describe various criteria for Integrability of functions.
3. Exhibit certain properties of mathematical objects such as integrable functions, analytic functions, harmonic functions and so on.
4. Prove some statements related to Riemann integration as well as in complex analysis.
5. Carry out the existing algorithms to construct mathematical structures such as analytic functions.
6. Applies the gained knowledge to solve various other problems.

Real Analysis - II

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) sums– definition, properties and problems. Riemann Integral–Upper and Lower integrals (definition and 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. Integrability of continuous functions, monotonic functions, bounded functions with finite number of discontinuities.

15 Hours

Unit-II : Riemann-Stieltjes and Improper Integrals

Riemann Stieltjes Integrals-Definition and example, Riemann Integral as a special case. Improper Integrals-Definitions and examples. Beta functions – definition, properties and problems, Gamma functions – definition, properties and problems. Relations between Beta and Gamma functions; standard theorems and problems, duplication formula and applications.

15 Hours

Complex Analysis

Unit-III : Complex numbers and functions of complex variables

Complex numbers-Cartesian and polar form-geometrical representation – complex plane-Euler's formula. Functions of a complex variable-limit, continuity and differentiability of a complex function. Analytic function, Cauchy-Riemann equations in Cartesian form, conditions for analyticity, standard properties of analytic functions-construction of analytic function when real or imaginary part is given - Milne Thomson method. Harmonic functions and problems there on.

15 Hours

Unit-IV : Complex Integration and Bilinear 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 line integrals.

Bilinear transformations-Definition and examples. Cross- ratio of four points - Cross-ratio preserving property- Preservation of the family of straight lines and circles. Conformal mappings- Definition and discussion of standard examples.

15 Hours

Reference Books:

1. S.C.Malik, Principles of Real Analysis, New Age International (India) Pvt.Ltd., 4th Edition, 2018.
2. S.C.Malik and Savita Arora, Mathematical Analysis, 5th edition, New Delhi, India: New Age international(P)Ltd., 2017.
3. Richard R Goldberg, Methods of Real Analysis, Oxford and IBH Publishing
4. Ajit Kumr and S. Kumaresan - A Basic Course in Real Analysis, Taylor and Francis Group.
5. L.V.Ahlfors, Complex Analysis, 3rd Edition, Mc Graw Hill Education
6. Bruce P.Palka, Introduction to the Theory of Function of a Complex Variable, Springer
7. Serge Lang, Complex Analysis, Springer
8. Shanthinarayan, Theory of Functions of a Complex Variable, S. Chand Publishers.
9. S.Ponnuswamy, Foundations of Complex Analysis, 2nd Edition, Alpha Science International Limited.
10. R.V.Churchil & J.W.Brown, Complex Variables and Applications, 5th ed, Mc Graw Hill Companies.

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

1. Learn Free and Open Source Software (FOSS) tools for computer programming.
2. Solve problem on Real Analysis and Complex Analysis studied in MATDSCT 5.1 by using FOSS software's.
3. Acquire knowledge of applications of Real Analysis and Complex Analysis through FOSS.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's: Maxima/Scilab /Python/Matlab

Suggested Programs:

1. Program to check whether a given set of real numbers attains supremum or infimum.
2. Program to find upper and lower Riemann sums with respect to given partition
3. Program to test Riemann Integrability.
4. Program to evaluate Riemann integral as a limit of sum
5. Program on verification of Cauchy – Riemann equations (Cartesian form) or test for analyticity.

6. Program on verification of Cauchy – Riemann equations (Polar form) or test for analyticity.
7. Basic commands on gamma and beta functions with examples
8. Evaluation of integral value of various functions using gamma and beta functions.
9. Program to check whether a function is harmonic or not.
10. Program to construct analytic functions (through Milne–Thompson method)
11. Program to find Cross ratio of points and related aspects.
12. Program to find fixed points of bilinear transformations.

Syllabus for B.A./B.Sc. with Mathematics
SEMESTER – V

MATDSCT5.2 : Advanced Algebra and Vector Calculus	
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:

1. Identify and analyze different algebraic structures such as normal subgroups, rings, integral domains, division ring and fields.
2. Explore the properties of the above mentioned algebraic structures.
4. Prove various statements related to algebraic structures .
5. To solve isomers using isomorphism concept.
6. Apply the gained knowledge to solve various other problems.
7. Get introduced to fundamentals of vector calculus.
8. Get familiar with the various differential operators and their properties.
9. Learn the applications of vector calculus.
10. Learn about the applications of Serret-frenet formulae.

Advanced Algebra

Unit I: Groups-II

Normal Subgroups – properties, examples and problems, Quotient group, Homomorphism and Isomorphism of groups – properties examples and problems, Kernel and Range of a homomorphism, Normality of the Kernel, Fundamental theorem of homomorphism, Properties related to isomorphism.

15 hours

Unit II: Rings, Integral Domains and Fields

Definition and properties of rings, Rings of integers modulo n, Subrings, Ideals - Principal, Prime and Maximal ideals in a commutative ring - examples and standard properties following the definition, Homomorphism, Isomorphism – properties, Quotient rings, Integral Domain, Fields – properties following the definition, Fundamental Theorem of Homomorphism of Rings, Every field is an integral domain, Every finite integral domain is a field with examples.

15 hours

Vector Calculus

Unit-III: Geometry of Space Curves

Multiple product-scalar triple product, vector triple product, geometrical interpretation, relative problems; vector function of scalar variable-interpretation as a space curve**,** derivative, tangent, normal and binormal vectors to space curve, curvature and torsion of a space curve-definitions, derivations and problems. Serret-frenet formulae.

15 hours

Unit-IV: Vector Calculus

Gradient of a scalar field, geometrical meaning, directional derivative, unit normal using surfaces- tangent plane and normal to the surface; Vector field –divergence and curl of a vector field, geometrical meaning, solenoidal and irrotational fields; Laplacian of a scalar field; Vector identities.

15 hours

Reference Books:

1. I N Herstein (1990), Topics in Algebra, 2nd Edition, Wiley Eastern Ltd., New Delhi.
2. Vijay K Khanna and SK Bhambri (1998), A Course in Abstract Algebra,Vikas Publications.
3. Michael Artin (2015), Algebra, 2nded., Pearson.
4. Joseph A, Gallian (2021), Contemporary Abstract Algebra, 10th edition., Taylor and Francis Group.
5. Murray R Spiegel – Theory and problems of vector calculus.
6. Shanthinarayan and J N Kapur – A text book of Vector calculus.
7. A text of B.Sc., Mathematics by G K Rangnath, S Chand Publications, Bangalore.
8. A text of B.Sc., Mathematics by B G Gururajachar, Academic Excellent Series Publications, Bangalore.

MATDSCP 5.2 :Practical's on Advanced Algebra and Vector Calculus	
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

1. Learn Free and Open Source Software (FOSS) tools for computer programming
2. Solve problems related to Analytical Geometry and Vector Calculus using FOSS software.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software: Maxima/Scilab /Python/R.

Suggested Programs:

1. Program to find all subgroups of a given group.
2. Program to verify Legrage's theorem.
3. Program to verify Homomorphism of given function.
4. Program to verify Isomorphism of given mapping.
5. Program to find whether given finite set is ring or not?
6. Program to show whether given subset of a finite ring is a subring or Not?
7. Program to find whether given subset of a finite ring is an ideal or not?
8. Program to find whether given function is a homomorphism or not?

9. Program to find whether given function is an isomorphism or not?
10. Program on multiple product of vectors – Scalar and Cross product.
11. Program on vector differentiation and finding unit tangent.
12. Program to find curvature and torsion of a space curve.
13. Program to find the gradient and Laplacian of a scalar function, divergence and curl of a vector function.
14. Program to demonstrate the physical interpretation of gradient, divergence and curl.

Syllabus for B.A./B.Sc. with Mathematics
SEMESTER – VI

MATDSCT6.1 : Linear Algebra and Fourier Series	
Teaching Hours : 4 Hours/Week	Credits : 4
Total Teaching Hours : 60 Hours	Max. Marks: 100 (S.A.-60 + I.A.-40)

Course Learning Outcomes:

The overall expectation from this course is that the student will build a basic understanding in few areas of linear algebra such as vector spaces, linear transformations and inner product spaces. Some broader course outcomes are listed as follows. At the end of this course, the student will be able to

1. Understand the concepts of Vector spaces, subspaces, bases, dimension and their properties.
2. Learn properties of inner product spaces and determine orthogonality in inner product spaces.
3. Prove various statements in the context of vector spaces.
4. Realize importance of adjoint of a linear transformation and its canonical form.
5. Know about difference between even and odd functions.
6. Find the period of any trigonometric functions.
7. To expand any periodic function as a Fourier series.

Linear Algebra

Unit-I: Vector spaces

Vector spaces - Definition, examples and properties; Subspaces - Examples, criterion for a sub set to be a subspace and some properties; 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; Basis and Dimension - Co-ordinates, ordered basis, some basic properties of basis and dimension and subspace spanned by given set of vectors.

15 Hours

Unit – II: Linear Transformations

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

15 Hours

Unit-III: Inner product Spaces

Inner product space – Definition and examples. Cauchy-Schwartz inequality, triangular inequality and related problems; Orthogonal vectors, orthonormal basis, problems on

Gram-Schmidt orthogonalization process: both proof and problems; Orthogonal projection; orthogonal projection of a vector and a subspace on another subspace, problems there on.

15 Hours

Fourier Series

Unit-IV : Fourier Series

Periodic function-Definition, properties and related problems. Even and Odd functions-Definition and problems. Fourier series expansion of $f(x)$ in the range $[c, c+2l]$, expansion of $f(x)$ in different intervals like $(-\pi, \pi)$ and $(0,2\pi)$ functions with period 2π and $2l$. Half range Fourier series – Definition and construction of half range sine series, definition and construction of half range cosine series.

15 hours

Reference Books:

1. N. Herstein, Topics in Algebra, 2nd Edition,Wiley.
2. Stephen H. Friedberg, ArnoldJ.Insel & Lawrence E.Spence (2003), Linear Algebra (4th Edition), Printice-Hall of India Pvt.Ltd.
3. F.M.Stewart, Introduction to Linear Algebra, Dover Publications.
4. S.Kumaresan, Linear Algebra, Prentice Hall India Learning Private Limited.
5. Kenneth Hoffman & Ray Kunze (2015), Linear Algebra, (2ndEdition), Prentice Hall India Leaning Private Limited.
6. Gilbert.Strang (2015), Linear Algebra and its applications, (2ndEdition), Elsevier.
7. VivekSahai &VikasBist (2013), Linear Algebra (2ndEdition) Narosa Publishing.
8. Serge Lang (2005), Introduction to Linear Algebra (2ndEdition), SpringerIndia.
9. T.K.Manicavasagam Pillai and K S Narayanan, Modern Algebra Volume2
10. A text of B.Sc., Mathematics by G K Rangnath, S Chand Publications, Bangalore.
11. A text of B.Sc., Mathematics by B G Gururajachar, Academic Excellent Series Publications, Bangalore.

MATDSCP 6.1 : Practical's on Linear Algebra and Fourier Series	
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

1. Learn Free and Open Source Software (FOSS) tools for computer programming
2. Solve problem on Linear Algebra studied in MATDSCT 6.1 by using FOSS software's.
3. Acquire knowledge of applications of Linear Algebra through FOSS.

Practical/Lab Work to be performed in Computer Lab (FOSS) Suggested Software's: Maxima/Scilab /Python

Suggested Programs:

1. Program on linear combination of vectors.
2. Program to verify linear dependence and independence.
3. Program to find basis and dimension of the subspaces.
4. Program to verify if a function is linear transformation or not.

5. Program to find the matrix of linear transformation.
6. Program on Rank – nullity theorem.
7. Program to verify if the given linear transformation is singular/non-singular.
8. Program to find the minimal polynomial of given transformation.
9. To plot periodic functions with period 2π and 2L
10. To find full range trigonometric Fourier series of some simple functions with period 2π and 2L.
11. Plotting of functions in half-range and including their even and odd extensions.
12. To find the half-range sine and cosine series of simple functions.
13. To find the half-range sine and cosine series of simple functions.

Syllabus for B.A./B.Sc. with Mathematics
SEMESTER – VI

MATDSCT6.2 : 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:

The overall expectation from this course is that the student will get equipped with certain numerical techniques for various computations such as finding roots, finding the integrals and derivatives, and finding solutions to differential equations. Some broader course outcomes are listed as follows. At the end of this course, the student will be able to

1.Describe various operators arising in numerical analysis such as difference operators, shift operators and so on.
2. Articulate the rationale behind various techniques of numerical analysis such as in finding roots, integrals and derivatives.
3. Reproduce the existing algorithms for various tasks as mentioned previously in numerical analysis.
4. Apply the rules of calculus and other areas of mathematics in justifying the techniques of numerical analysis.
5. Solve problems using suitable numerical technique.
6. Appreciate the profound applicability of techniques of numerical analysis in solving real life problems and also appreciate the way the techniques are modified to improve the accuracy.

Numerical Analysis

Unit-I : Algebraic and Transcendental Equations

Algebraic and Transcendental Equations. Errors - significant digits, absolute, relative, percentage errors, rounding off and truncation. Solutions to algebraic and transcendental equations - Bisection method, Regula-Falsi method, iterative method: Newton-Raphson method and Secant method.

15 Hours

Unit-II : Polynomial Interpolations

Finite differences; Forward and backward differences and shift operators: definitions, properties and problems; Polynomial interpolation-Newton-Gregory forward and backward interpolation formulae, Lagrange interpolation formula, Newton’s divided difference interpolation formula.

15 Hours

Unit-III : Numerical Differentiation and Integration

Formula for derivatives (till second order) based on Newton-Gregory forward and backward interpolations. Numerical Integration-General quadrature formula, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 th rule and Weddle's rule.

15 Hours

Unit: IV Numerical Solutions of Ordinary Differential Equations

Numerical solution of ordinary differential equations of first order and first degree by Picard's method, Euler's method, Euler's modified method and Runge-Kutta method of fourth-order (No derivations of formula).

15 Hours

Reference Books:

1. E.Isaacson and H.B.Keller, Analysis of Numerical methods, Dover Publications.
2. S.S. Sastry, Introductory methods of Numerical Analysis, 5thEdition, PHI Learning Private Limited.
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, 4thEdition, New Age International
6. H.C.Saxena, Finite Difference and Numerical Analysis, S.Chand Publishers
7. B.D.Gupta, Numerical Analysis, Konark Publishers Pvt.Ltd.

MATDSCP 6.2 : Practical's on **Numerical 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

1. Learn Free and Open Source Software (FOSS) tools for computer programming.
2. Solve problem on numerical Analysis studied in MATDSCT 6.2 by using FOSS software's.
3. Acquire knowledge of applications of Numerical Analysis through FOSS.

Practical/Lab Work to be performed in Computer Lab (FOSS)
Suggested Software's: Maxima/Scilab /Python.

Suggested Programs:

1. Program to find root of an equation using bisection method.
2. Program to find root of an equation using Regula-Falsi method.
3. Program to find root of an equation using Newton-Raphson method.
4. Program to find root of an equation using Secant methods method.
5. Program to evaluate integral using Simpson's 1/3 and 3/8 rules.
6. Program to evaluate integral using Trapezoidal rule.
7. Program to evaluate integral using Weddle rule.
8. Scilab/Maxima programs on Interpolations with equal intervals.

9. Program to find differentiation at specified point using Newton-Gregory interpolation method.
10. Program to find the missing value of table using Lagrange method.
11. Solving ordinary differential equation by modified Euler's method.
12. Solving ordinary differential equation by Runge-Kutta method of 4^{th} order.

QUESTION PAPER PATTERN FOR B.A/B.Sc., DEGREE COURSES

(DSC……...)

…….Semester…….Degree Examination……..202……..

(NEP Scheme)

Paper: DSC…….……

Time:02 Hours **Max. Marks:60**

Instructions to Students

1. The students should legibly write section number along with question numbers
2. The answers without section number and question numbers will not be valued
3. The question numbers should be legibly written within the margin only

Section – I

I. Select the most appropriate answer from the options provided: 10 × 1 = 10

I-1) ……

a) b) c) d)

I-2) ……

a) b) c) d)

.

.

I-10) ……

a) b) c) d)

Section - II

II. Answer any FIVE of the following: 05 × 03 = 15

II-1)
II-2)
II-3)
II-4)
II-5)
II-6)
II-7)
II-8)

Section - III

III. Answer any THREE of the following: 03 × 05 = 15

II-1)
II-2)
II-3)
II-4)
II-5)

Section - IV

VI. Answer the following* 02 × 10 = 20

IV-1) ……..

OR

……

IV-2) ……..

OR

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*May have sub questions if required

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