KUVEMPU UNIVERSITY

SYLLABUS

COURSE: B. Sc. MATHEMATICS

Revised on: 2017-18

With Effective from A/Y: 2018-19

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Structure of B.Sc. Mathematics papers

Semester	Title of the paper		Teaching hrs/week	Duration of Exam (hrs)	IA MARKS	EXAM MARKS	TOTAL MARKS	Semester Total
I	BSM 1	Theory	5 hrs	3 hrs	10	70	80	100
		Practical	3 hrs	3 hrs	-	20	20*	
II	BSM 2	Theory	5 hrs	3 hrs	10	70	80	100
		Practical	3 hrs	3 hrs	-	20	20	
III	BSM 3	Theory	5 hrs	3 hrs	10	70	80	100
		Practical	3 hrs	3 hrs	-	20	20	
IV	BSM 4	Theory	5 hrs	3 hrs	10	70	80	100
		Practical	3 hrs	3 hrs	-	20	20	
V	BSM 5	Theory	4 hrs	3 hrs	10	70	80	100
		Practical	2 hrs	3 hrs	-	20	20	
	BSM 6	Theory	4 hrs	3 hrs	10	70	80	100
		Practical	2 hrs	3 hrs	-	20	20	
VI	BSM 7	Theory	4 hrs	3 hrs	10	70	80	100
		Practical	2 hrs	3 hrs	-	20	20	
	BSM 8	Theory	4 hrs	3 hrs	10	70	80	100
		Practical	2 hrs	3 hrs	-	20	20	

* **In the Practical component outof 20 marks: 15 for practical exam + 3 for vivo +2 for lab record.**

KUVEMPU UNIVERSITY

Syllabus

B.Sc. Mathematics (Theory and Practicles)

I SEMESTER

Paper - BSM 1: Algebra - I and Calculus - I

Total: 78 Hrs

Matrices: Symmetric and Skew Symmetric matrices, Algebra of Matrices; Row and column reduction, Echelon form, Rank of a matrix; Inverse of a matrix by elementary operations; 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. Eigen values and Eigen vectors of square matrices, real symmetric matrices and their properties, reduction of such matrices to diagonal form, Cayley-Hamilton theorem, inverse of matrices by Cayley-Hamilton theorem.

02hrs/week=30hrs

Polar Co-ordinates: Polar coordinates, angle between the radius vector and tangent. Angle of Intersection of curves (polar forms), pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature.

Successive Differentiation: nth Derivative of $(ax+b)^m$, $\log(ax+b)$, e^{ax}, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$, $\sin(ax+b)$, $\cos(ax+b)$, Leibnitz theorem (with proof) and applications.

Function of two and three variables: continuity, partial derivatives EULERS Theorem, maxima and minima (Two variables).

03hrs/week=48hrs

Reference Books:

1. Topics in Algebra - I N Herstain, Publisher John Wiley & Sons.
2. University Algebra - N.S. Gopalakrishnan, New Age International (P) Limited
3. Theory of Matrices - B S Vatsa, New Age International Publishers.
4. Matrices - A R Vasista, Krishna Prakashana Mandir.
5. Elements of Real Analysis - Shanti Narayan, S. Chand & Company, New Delhi.
6. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
7. Calculus – Lipman Bers, Holt, Rinehart & Winston.
8. Calculus - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd., vol. I & II.
9. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw Hill., 2008.

PRACTICAL – 1:

Total: 42Hrs

Practicals with Free and Open Source Software (FOSS) tools for computer programs
(3 hours/ week per batch)
Softwares used: 1. Maxima
2. Scilab

Level - 1: Fundamental Computer Applications

1. **Word:** Creating documents, saving in personal folders, sending files to the other users through email-id (documents include all kind of mathematical equations with Greek letters, differentiations, integrations, matrices, vectors, etc.).
2. **Excel:** Creating documents, save in personal folders, sending files through emails to other users (documents contains employees' salaries, students' marks with total, average, division, student attendance list, etc.).
3. **Power point:** Create power point presentation documents which includes Mathematical equations and solutions, programs copy from Scilab, Maxima etc.
4. **Mails creation:** Creating email-id through sign up through Google/Yahoo/Rediff etc. attaching files, sending messages to other mail-ids.

3 hrs/week - 12 hrs.

Level - 2: Basics in Scilab and Maxima

1. **Procedure of opening Scilab console and Scilab notes.**
   a) Writing mathematic functions and commands on console.
   b) Writing procedure – syntax in Sci-notes (i) If, (ii) If-else, (iii) nested-if, (iv) while-loop, (v) for-loop with example, (vi) Arrays, etc.

   Examples:
   - Various commands on Matrices (Addition of matrices, Multiplication of matrices, Inverse of the Matrix, etc.)
   - Programs to find the age for eligible to vote.
   - Programs to calculate the total and average of marks of students and check the division.
   - Program to reduce the given matrix into lower triangular and upper triangular matrices
   - Program to find Row reduced echelon form and normal form forgiven matrices.
   - Program to test consistency of system of linear equations and solutions.

   3 hrs/week - 15 hrs.

2. **Procedure of opening Maxima window for writing commands and programs.**
   a) Writing mathematic functions and commands on Maxima window.
   b) Writing procedure – syntax in Maxima window (i) If, (ii) If-else, (iii) nested-if, (iv) while-loop, (v) for-loop with example, (vi) Arrays, etc.

   Examples:
   - Various commands on Matrices (Addition of matrices, Multiplication of matrices, Inverse of the Matrix, etc.)
   - Programs to find the age for eligible to vote.
   - Programs to calculate the total and average of marks of students and check the division.
   - Program to find Eigen values and Corresponding Eigen vectors of the matrix using MAXIMA.

- Program to verify the Cayley-Hamilton theorem for given matrix using MAXIMA
- Introduction to Maxima and commands for successive derivatives and Leibnitz rule.

3 hrs/week - 15 hrs.

II SEMESTER

Paper - BSM 2: Algebra – II and Calculus - II

Total: 78 Hrs

Groups: Definition of a group with examples and properties, Problems there on, Subgroups, center of groups, order of an element of a group, order of a group, cyclic groups, Coset decomposition, Lagrange's theorem and its consequences. Fermat's theorem and Euler's theorem.

02hrs/week=30hrs

Theory of plane Curves: Asymptotes, envelopes, singular points, cusp, node, and conjugate points.

Mean value Theorems: Continuity and differentiability (Definitions only). Theorems on derivatives: Rolle's Theorem, Lagrange's mean value theorem and Cauchy mean value theorem. Taylor's and Maclaurin's series (problems only).

L'Hospital's rule: Statement of L' Hospital's rule and problems there on.

02hrs/week=32hrs

Integral calculus: Recapitulation of Algebraic rational and irrational functions and rational functions involving trigonometric functions and definite integrals. Reduction Formulae for $\int sin^n x$, $\int cos^n x$, $\int tan^n x$, $\int cot^n x$, $\int sec^n x$, $\int cosec^n x$, $\int sin^m x \, cos^m x dx$ with definite limit. Differentiation under the integral sign by Leibnitz rule.

01hrs/week=16hrs

Reference Books:

1. Higher algebra - Bernard & Child, Arihant, ISBN: 9350943199/ 9789350943199.
2. Topics in Algebra - I N Herstain, Wiley Eastern Ltd., New Delhi.
3. Modern Algebra - Sharma and Vasishta, Krishna Prakashan Mandir, Meerut, U.P.
4. Analytical Solid Geometry - Shanti Narayan, New Delhi: S. Chand and Co. Pvt. Ltd., 2004
5. Textbook of BSc Mathematics - Chakravarthy L.N, Vol 1, ISBN: 1234567176244, Chethana Book House
6. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
7. Integral Calculus - Shanti Narayan and P K Mittal, S. Chand and Co. Pvt. Ltd.,
8. Schaum's Outline of Calculus - Frank Ayres and Elliott Mendelson, 5th ed. USA: Mc. Graw Hill., 2008.

PRACTICAL - 2

Total: 42 Hrs

Practicals with Free and Open Source Software (FOSS) tools for computer programs
(3 hours/ week per batch)
Softwares used: 1. Maxima
2. Scilab

LIST OF PROGRAMMES

1. Program to construct Cayley table and test abelian for given finite set using SCILAB.
2. Program to test abelian group properties for given finite set using SCILAB
3. Program to find all possible cosets of the given finite group using SCILAB
4. Program to find all generators and corresponding all possible subgroups for the given cyclic group using SCILAB
5. Programs to verify Lagrange's theorem for given finite group.
6. Program to verify the Euler's theorem for given finite group using SCILAB.
7. Programs for finding limits by comparing left and right limits using MAXIMA
8. Programs for testing continuity of the function at $x = a$ and x in $[a, b]$ using MAXIMA
9. Programs for testing differentiability of the function at $x = a$ and x in (a, b) using MAXIMA
10. Programs to verify Rolle's theorem for given function using MAXIMA
11. Programs to verify Lagrange's mean value theorem for given function using MAXIMA
12. Programs to verify Cauchy's Mean value theorem using MAXIMA
13. Programs to verify Taylor's Mean value theorem using MAXIMA
14. Programs to construct series using Maclaurin's series
15. Programs to find limit of the function using L'Hosptal's rule.

III SEMESTER

Paper - BSM 3: Algebra - III and Differential Equations - I

Total: 78 Hrs

Group Theory: Normal Subgroups, definition, examples and standard theorems on normal subgroups**.** Quotient groups, Homomorphism, isomorphism and fundamental theorem of homomorphism of groups.

02hrs/week=30hrs

Ordinary Differential Equation: Definition of an ordinary differential equation, its order and degree. Classification of solutions. Solution of first degree and first order equations.
(1) Variable separable
(2) Homogeneous and reducible to homogeneous form.
(3) Linear and Bernoulli's form
(4) Exact equations and reducible to exact form with standard I.F. Necessary and sufficient condition for the equation to be exact.

Equations of first order and higher degree. Solvable for p, Solvable for x (singular solutions), Solvable for y (singular solutions) and Clairaut's equation. Orthogonal trajectories. Second and higher order linear differential equations with constant co-efficient, complementary functions, Particular integral, standard types, Cauchy-Euler differential equations. Simultaneous differential equations with constant co-efficient (two variables).

03hrs/week=48hrs

Reference Books:

1. Higher algebra - Bernard & Child, Arihant, ISBN: 9350943199/ 9789350943199.
2. Topics in Algebra - I N Herstain, Wiley Eastern Ltd., New Delhi.
3. Modern Algebra - Sharma and Vashishta, Krishna Prakashan Mandir, Meerut, U.P.
4. Textbook of BSc Mathematics - Chakravarthy L.N, Vol 2, ISBN:1234567176245, Chethana Book House.
5. Ordinary and Partial Differential Equations - M D Raisinghania, S. Chand and Co. Pvt. Ltd.
6. Schaum's outline of theory and problems of Differential Equations - Frank Ayres, McGraw-Hill Publishing Co.
7. Differential Equations and Its Applications - S Narayanan and T K Manicavachagom Pillay, S V Publishers Private Ltd.
8. Differential equation with Applications and Historical Notes - G F Simmons, 2nd ed. McGraw-Hill Publishing Company.

PRACTICAL - 3

Total: 42 Hrs

Practicals with Free and Open Source Software (FOSS) tools for computer programs
(3 hours/ week per batch)
Softwares used: 1. Maxima
2. Scilab

LIST OF PROGRAMMES

1. Program to test normality of a given subgroup and a group using SCILAB.
2. Program to test homomorphism of a give function from $G \rightarrow G'$using SCILAB.
3. Program to test isomorphism of a given function from $G \rightarrow G'$ using SCILAB.
4. Program to find the solution of given differential equation using Maxima and plotting the Solution-I. (1st order 1st degree non-linear)
5. Program to find the solution of given differential equation using Maxima and plotting the solution-II. (1st order 1st degree linear)
6. Program to find the solution of given differential equation using Maxima and plotting the solution-III. (1st order but not of 1st degree)
7. Program to find complementary function and particular integral of given differential equation with constant coefficients.
8. Program to find solution of given simultaneous differential equations with constant coefficients.
9. Programs for plotting curves in 2D Plane which are in Cartesian form.
10. Programs for plotting curves in 2D Plane which are in polar form.
11. Programs for plotting curves in 2D Plane which are in Parametric form.
12. Programs for plotting curves in 3D space using MAXIMA/SCILAB.

IV SEMESTER

Paper - BSM 4: Differential Equations - II and Analysis

Total: 78 Hrs

Ordinary Linear Differential Equations: Solution of ordinary second order linear differential equation with variable coefficients by the methods:
1. When a part of complementary function is given,
2. Changing the independent variable,
3. Changing the dependent variable,
4. When a first integral is given (exact equation),
5. Variation of parameters

02hrs/week=30hrs

Sequence of Real Numbers: Definition of a sequence, limits of a sequence, algebra of limit of a Sequence-Convergent, Divergent and Oscillatory sequence problems there on. Bounded sequence; every convergent sequence is bounded-converse is not true, Monotonic Sequence and Their properties, Cauchy's sequence.

Infinite Series: Definition of convergent, divergent and oscillatory of series - standard properties and results, Geometric and Hyper geometric series. Cauchy's criterion (statement only). Tests of convergence of series - comparison tests - D'Alemberts Ratio test - Raabe's test - Cauchy's root test. The Integral test - Absolute Convergence and Leibnitz's test for alternating series.

03hrs/week=48hrs

Reference Books:

1. Ordinary and Partial Differential Equations - M D Raisinghania, S. Chand and Co. Pvt. Ltd.
2. Schaum's outline of theory and problems of Differential Equations - Frank Ayres, McGraw-Hill Publishing Co.
3. Differential Equations and Its Applications - S Narayanan and T K Manicavachagom Pillay, S V Publishers Private Ltd.
4. Differential equation with Applications and Historical Notes - G F Simmons, 2nd ed.: McGraw-Hill Publishing Company.
5. Elements of Real Analysis - Shanti Narayan, S. Chand & Company, New Delhi.
6. Mathematical Analysis - S. C. Malik, Savita Arora, New Age Science Ltd.
7. Principles of Mathematical Analysis - Walter Rudin, McGraw-Hill Publishing Company.

PRACTICAL - 4

Total: 42 Hrs

Practicals with Free and Open Source Software (FOSS) tools for computer programs
(3 hours/ week per batch)
Softwares used: 1. Maxima

2. Scilab

LIST OF PROGRAMMES

1. Program to find the solution of Differential Equations by finding complimentary functions
2. Program to find the solution of Differential Equations by changing independent variable.
3. Program to find the solution of Differential Equations by changing dependent variable.
4. 4Program to test for exactness and solve the Differential Equations of second order.
5. Program to illustrate convergence, divergence or oscillatory of the given sequence using SCILAB/MAXIMA.
6. Program to illustrate convergence, divergence or oscillatory of the given series using SCILAB/MAXIMA.
7. Using Cauchy's criterion to determine convergence of the given sequence.
8. Using Cauchy's criterion to determine convergence of the given series.
9. Program to test the convergence of the series using Leibnitz's theorem.

V SEMESTER

Paper - BSM 5: Differential Equations– III, Fourier series and Algebra-IV

Total: 60 Hrs

Total and Simultaneous Differential Equations: Necessary condition for the equation $P\,dx + Q\,dy + R\,dz = 0$ to be integrable-problems there on. Solutions of equation of the $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

Partial Differential Equations: Formation of partial differential equation –Lagrange's linear equation:$Pp + Qq = R$. Four standard types of first order partial differential equations, Charpit's methods.

Fourier Series: Periodic functions and properties-Fourier series of functions with period 2π and period 2L. Half range cosine and sine series.

02hr/week=30hrs

Rings, Integral Domains and Fields: Rings- Definition, Types of rings. Examples properties of rings - Rings of Integers Modulo-n - Integral domains - Fields. Examples - subrings - Ideals -Principal ideals, Maximal ideal commutative rings, examples and standard properties- Homomorphism and Isomorphism - properties of homomorphism of rings. Quotient rings.

02hrs/week=30hrs

Reference Books:

1. Ordinary and Partial Differential Equations - M D Raisinghania, S. Chand and Co. Pvt. Ltd.
2. Schaum's outline of theory and problems of Differential Equations - Frank Ayres, McGraw-Hill Publishing Co.
3. Differential Equations and Its Applications - S Narayanan and T K Manicavachagom Pillay, S V Publishers Private Ltd.

4. Differential equation with Applications and Historical Notes - G F Simmons, 2nd ed.: McGraw-Hill Publishing Company.
5. Topics in Algebra - I N Herstain, Wiley Eastern Ltd., New Delhi.
6. Modern Algebra - Sharma and Vashishta, Krishna Prakashan Mandir, Meerut, U.P.
7. Textbook of BSc Mathematics - Chakravarthy L.N., Vol 2, ISBN:1234567176245, Chethana Book House.

PRACTICAL - 5

Total: 30Hrs

Practicals with Free and Open Source Software (FOSS) tools for computer programs
(2 hours/ week per batch)
Softwares used: 1. Maxima
2. Scilab

LIST OF PROGRAMMES

1. Program to find the solution of the given total differential equation.
2. Program to find the solution of the given simultaneous differential equations.
3. Program to find the solution of the given partial differential equation.
4. Program to find whether given finite set is ring or not?
5. Program to show whether given subset of a finite ring is a subring or Not?
6. Program to find whether given subset of a finite ring is an ideal or not?
7. Program to find whether given function is a homomorphism or not?
8. Program to find whether given function is an isomorphism or not?
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.

V SEMESTER

Paper - BSM 6: Line and Multiple Integrals and Laplace Transforms

Total: 60 Hrs

Line and Multiple Integrals: Definition of line integral and basic properties, examples on evaluation of line integrals. Definition of double integrals, evaluation of double integrals (1) under given limits (2) In regions bounded by given curves - change of variables, surface area as double integrals. Definition of triple integrals and evaluation, change of variables, volume as a triple integral.

02hrs/week=30hrs

Laplace Transforms: Definition and basic properties - Laplace transforms of e^{kt},$\cos kt$, $\sin kt$, t^n, $\cosh kt$ and $\sinh kt$ - Laplace transform of $e^{at}F(t)$, $t^n F(t)$, $F(t)/t$ - problems - Laplace transform of derivatives of functions - Laplace transforms of integrals of functions - Laplace

transforms of unit step functions - Inverse Laplace transforms - problems. Convolution theorem - Simple initial value problems - Solution of first and second order differential equations with constant coefficients by Laplace transform method.

02hrs/week=30hrs

Reference Books:

1. Integral Calculus - H.S. Dhami, New Age International Pvt. Ltd Publishers.
2. Text Book of Multiple Integrals - A.K. Sharma, Discovery Publishing House, New Delhi.
3. Differential and Integral Calculus, Vol. II - N. Piskunov, CBS Publishers & Distributors Pvt. Ltd.
4. Mathematical Analysis - S. C. Malik, Savita Arora, New Age Science Ltd.
5. Higher Engineering Mathematics - B.S. Grewal, Khanna publishers.
6. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley; Ninth edition, ISBN:8126531355
7. Schaum's Outline of Laplace Transforms - Murray Spiegel, McGraw-Hill Education
8. Laplace and Fourier Transforms - M. D. Raisinghania, New Delhi, India: S. Chand and Co. Ltd.

PRACTICAL - 6

Total: 30Hrs

Practicals with Free and Open Source Software (FOSS) tools for computer programs
(2 hours/ week per batch)
Softwares used: 1. Maxima
2. Scilab

LIST OF PROGRAMMES

1. Evaluation of the line integral with constant limits.
2. Evaluation of the double integral with constant limits.
3. Evaluation of the triple integral with constant limits.
4. Evaluation of the line integral with variable limits.
5. Evaluation of the double integral and triple integral with variable limits.
6. Evaluation of area of the surface as double integral.
7. Evaluation of volume of the solid as a triple integral.
8. Finding the Laplace transforms of some standard functions.
9. Finding the inverse Laplace transform of simple functions.
10. Program to Verify of Convolution Theorem.
11. Program to find the solution of a differential equation using Laplace transform method.

VI SEMESTER

Paper - BSM 7: Vector Space and Numerical Analysis

Total: 60 Hrs

Vector Space: Vector spaces, examples, subspaces, criterion for a subset to be a subspace. Concepts of linear dependence and independence. Fundamental theorem of linear dependence. Basis and dimension, standard properties of linearly independent and dependent sets examples, illustrations, concepts and results.

Linear transformations, Matrix representation of linear maps. Rank and nullity of a linear transformation.

02hrs/week=30hrs

Numerical Analysis: Solution of algebraic and transcendental equations of one variable by Bisection, Regula-Falsi and Newton-Raphson methods.

Finite differences (Forward and Backward differences) Interpolation, Newton's forward and backward interpolation formulae. Divided Differences-Newton's divided difference formula. Lagrange's interpolation formulae.

Numerical differentiation using Newton's forward and backward interpolation formulae.

Numerical Integration-Trapezoidal rule, Simpson's one-third and three - eight rule, Weddle's rule. (without proof).

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

02hrs/week=30hrs

Reference Books:

1. Herstain: Topics in Algebra, Wiley Eastern Ltd., New Delhi.
2. Modern Algebra - Sharma and Vashishta, Krishna Prakashan Mandir, Meerut, U.P.
3. Schaum's outline of Linear Algebra - Seymour Lipschutz, McGraw Hill Education.
4. The Linear Algebra a Beginning Graduate Student Ought to Know - Golan, Jonathan S, Springer International Publishing.
5. Introductory Methods of Numerical Analysis - S.S. Sastry, Prentice Hall India Learning Private Limited.
6. Numerical Methods: For Scientific and Engineering Computation - M.K. Jain, S.R.K. Iyengar, R.K. Jain, NEW AGE; 6th edition
7. Numerical Analysis - B. D Gupta, Stosius Inc/Advent Books Division.
8. Finite Difference and Numerical Analysis - H. C Saxena, S. Chand Publishing.
9. Numerical Methods for Scientists and Engineers - B. S. Grewal, Khanna Publishers.
10. Advanced Engineering Mathematics - E. Kreyszig.

PRACTICAL - 7

Total: 30Hrs

Practicals with Free and Open Source Software (FOSS) tools for computer programs
(2 hours/ week per batch)
Softwares used: 1. Maxima
2. Scilab

LIST OF PROGRAMMES

1. Program to verify given set is vector space or not?
2. Program to find whether given set is L.I or L.D.
3. Program to verify whether given function is basis or not?
4. Program to verify given mapping is Linear transformation or not?
5. Program to find matrix of a given linear transformation.
6. Program to find the rank and nullity of a linear transformation?
7. Scilab/Maxima programs on Interpolations with equal intervals.
8. Scilab/Maxima programs on Interpolations with unequal intervals.
9. Scilab/Maxima programs to evaluate integrals using trapezoidal, Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$rule.
10. Solving ordinary differential equation by modified Euler's method.
11. Solving ordinary differential equation by Runge-Kutta method of 4^{th} order.

VI SEMESTER

Paper - BSM 8: Riemann Integration, Vector Calculus and Complex Analysis

Total: 60 Hrs

Riemann Integrations: Upper and Lower sums, Refinement of partitions, upper and lower integrals, integrability, Criterion for integrability, continuous and monotonic functions are Riemann integrable, integral as the limit of a sum, integrability of the sum and product of integrable functions, integrability of the modulus of an integrable function, the fundamental theorem of calculus.

Vector Calculus: Scalar field – gradient of a scalar field, geometrical meaning – directional derivative – Maximum directional derivative – Angle between two surfaces - vector field– divergence and curl of a vector field – solenoidal and irrotational fields – scalar and vector potentials – Laplacian of a scalar field – vector identities. Standard properties,
Harmonic functions, Problems.

2hrs/week=30hrs

Complex Analysis: Complex numbers, the complex plane - conjugate and modulus of a complex number - the modulus-argument form - geometric representation - Equation to circle and line in the complex form.

Functions of a complex variable, limit, continuity and differentiability of function- Analytic function - Cauchy-Riemann equations in Cartesian form. Sufficient conditions for analytic (in Cartesian form). Real and imaginary parts of analytic functions are harmonic, construction of analytic function given real or imaginary parts.

02hrs/week=30hrs

Reference Books:

1. Mathematical Analysis - S. C. Malik, Savita Arora, New Age Science Ltd.
2. Principles of Mathematical Analysis - Walter Rudin, McGraw-Hill Publishing Company.
3. Real and Complex Analysis - Walter Rudin, McGraw-Hill Higher Education.
4. Elements of Real Analysis - Shanti Narayan, S. Chand & Company, New Delhi.
5. Complex Variables and Applications - James Brown, Ruel Churchill, McGraw-Hill.
6. Foundations of Complex Analysis - S. Ponnusamy, Narosa book distributors Pvt. Ltd.-New Delhi
7. Schaum's Outline of Complex Variables - Murray Spiegel, John Schiller, Seymour Lipschutz, McGraw-Hill Education.
8. Complex Analysis - Lars Ahlfors, McGraw-Hill Education.
9. Vector Calculus - Paul C. Matthews, Springer-Verlag London.
10. Golden Vector Calculus, R. Gupta, Laxmi Publications
11. A Textbook of Engineering Mathematics - N. P. Bali, N. Ch. Narayana Iyengar, Laxmi Publications.
12. Textbook of Vector Calculus - Shanti Narayan, S. Chand.

PRACTICALS - 8

Total: 30Hrs

Practicals with Free and Open Source Software (FOSS) tools for computer programs
(2 hours/ week per batch)
Softwares used: 1. Maxima
2. Scilab

LIST OF PROGRAMMES

1. Programmes to find lower and upper Riemann sum.
2. Programmes to find lower and upper Riemann integration.
3. To demonstrate the physical interpretation of gradient, divergence and curl.
4. Writing gradient, divergence, curl and Laplacian in cylindrical coordinates.
5. Writing gradient, divergence, curl and Laplacian in spherical coordinates.
6. Using cyclic notations to derive different vector identities.
7. Using cyclic notations to derive some more vector identities.
8. Programs to verify given functions satisfy Cauchy-Riemann equations both in Cartesian and polar form.
9. Implementation of Milne-Thomson method in constructing analytic functions (simple examples).
10. Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function.
11. Program to verify given function is harmonic or not.
12. Program to verify real part of an analytic function being harmonic.
13. Program to verify imaginary part of an analytic function being harmonic.

PATTERN OF THE QUESTION PAPER

FROM 1st TO 6th SEMESTER

Time:3 Hours **Max.Marks:70**

I	Answer any FIVE of the following (8 questions are given)	$5 \times 2 = 10$ Marks
II	Answer any THREE of the following (05 questions are given)	$3 \times 5 = 15$ Marks
III	Answer any THREE of the following (05 questions are given)	$3 \times 5 = 15$ Marks
IV	Answer any THREE of the following (05 questions are given)	$3 \times 5 = 15$ Marks
V	Answer any THREE of the following (05 questions are given)	$3 \times 5 = 15$ Marks

PATTERN OF THE QUESTION PAPER

PAPER -BSM 1

Time:3 Hours Max.Marks:70

NOTE: Answer All Questions

I. Answer any **FIVE** of the following: Marks: $5 \times 2 = 10$

1. 2. 3. } Matrices
4. 5. } Polar Co-ordinates
6. } Successive Differentiation
7. 8. } Function of two and three variables

II. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Matrices

III. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. } Matrices
4. 5. } Polar Co-ordinates

IV. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. } Polar Co-ordinates
4. 5. } Successive Differentiation

V. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. } Successive Differentiation
3. 4. 5. } Function of two and three variables

PAPER - BSM 2

Time:3 Hours Max.Marks:70

NOTE: Answer All Questions

I. Answer any **FIVE** of the following: Marks: $5 \times 2 = 10$

1. 2. } Groups
3. } Theory of plane Curves
4. 5. } Mean value theorems
6. } L'Hospital's rule
7. 8. } Integral Calculus

II. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Groups

III. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. } Theory of plane Curves
3. 4. 5. } Mean value Theorems

IV. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. } Mean value Theorems
3. 4. 5. } L'Hospital's rule

V. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Integral Calculus

PAPER - BSM 3

Time:3 Hours Max.Marks:70

NOTE: Answer All Questions

I. Answer any **FIVE** of the following: Marks: $5 \times 2 = 10$

1.
2.
3. } Group Theory

4.
5.
6.
7.
8. } Ordinary Differential Equation

II. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1.
2.
3.
4.
5. } Group Theory

III. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1.
2.
3.
4.
5. } Ordinary Differential Equation (up to Exact)

IV. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1.
2.
3.
4.
5. } Ordinary Differential Equation (after Exact up to orthogonal trajectories)

V. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1.
2.
3.
4.
5. } Ordinary Differential Equation (Higher order and simultaneous equations)

PAPER - BSM 4

Time:3 Hours Max.Marks:70

NOTE: Answer All Questions

I. Answer any **FIVE** of the following: Marks: $5 \times 2 = 10$

1.
2.
3.
4. } Ordinary Linear Differential Equations

5.
6.
7.
8. } Sequence and Series

II. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Ordinary Linear Differential Equations

III. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. } Ordinary Linear Differential Equations
3. 4. 5. } Sequence of Real Numbers

IV. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. } Sequence of Real Numbers
4. 5. } Infinite Series

V. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. } Infinite Series
4. 5. } The Integral testand Leibnitz's test

PAPER - BSM 5

Time:3 Hours Max.Marks:70

NOTE: Answer All Questions

I. Answer any **FIVE** of the following: Marks: $5 \times 2 = 10$

1. 2. } Total and Simultaneous Differential Equations
3. 4. } Partial Differential Equations
5. 6. } FourierSeries
7. 8. } Rings, Integral Domains and Fields

II. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. } Total and Simultaneous Differential Equations
5. } Partial Differential Equations

III. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. } Partial Differential Equations
4. 5. } FourierSeries

IV. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. } FourierSeries
3. 4. 5. } Rings (up to Subrings)

V. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Rings (From Ideals to till end)

PAPER - BSM 6

Time:3 Hours Max.Marks:70

NOTE: Answer All Questions

I. Answer any **FIVE** of the following: Marks: $5 \times 2 = 10$

1. 2. 3. 4. } Line and Multiple Integrals
5. 6. 7. 8. } Laplace Transforms

II. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. } Line Integrals
3. 4. 5. } Double Integrals

III. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. } Double Integrals
3. 4. 5. } Triple Integrals

IV. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Laplace Transforms

V. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Laplace Transforms

PAPER - BSM 7

Time:3 Hours Max.Marks:70

NOTE: Answer All Questions

I. Answer any **FIVE** of the following: Marks: $5 \times 2 = 10$

1.
2.
3.
4. } Vector Space

5.
6.
7.
8. } Numerical Analysis

II. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1.
2.
3.
4.
5. } Vector Space (up to basis and dimensions)

III. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1.
2.
3.
4.
5. } Vector Space (Linear transformation till end)

IV. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1.
2.
3.
4.
5. } Numerical Analysis (up to numerical differentiation)

V. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1.
2.
3.
4.
5. } Numerical Analysis (numerical integration till end)

PAPER - BSM 8

Time:3 Hours Max.Marks:70

NOTE: Answer All Questions

I. Answer any **FIVE** of the following: Marks: $5 \times 2 = 10$

1.
2. } Riemann Integrations

3.
4. } Vector Calculus

5.
6.
7.
8. } Complex Analysis

II. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Riemann Integrations

III. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Vector Calculus

IV. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Complex Analysis (up to analytic functions)

V. Answer any **THREE** of the following: Marks: $3 \times 5 = 15$

1. 2. 3. 4. 5. } Complex Analysis (from analytic functions till

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