VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

Mathematics

V Semester Syllabus

Bachelor of Science

With effect from 2021-22 and onwards

Index:

Curriculum Structure

Program: B.Sc Subject: Mathematics

Semester	Course No.	Theory/ Practical	Credits	Paper Title	Marks	
					S.A.	I.A.
V	DSC5	Theory	4	Real Analysis-II & Complex Analysis	60	40
	DSC5-Lab	Practical	2	Practical's on Real Analysis-II & Complex Analysis	25	25
	DSC6	Theory	4	Vector Calculus and Analytical Geometry	60	40
	DSC6-Lab	Practical	2	Practical's on Vector Calculus and Analytical Geometry	25	25
VI	DSC7	Theory	4	Linear Algebra	60	40
	DSC7-Lab	Practical	2	Practical's on Linear Algebra	25	25
	DSC8	Theory	4	Numerical Analysis	60	40
	DSC8-Lab	Practical	2	Practical's on Numerical Analysis	25	25

B.Sc V Semester

DSC5: Real Analysis-II & Complex Analysis

Course Title: Real Analysis-II & Complex Analysis	Course code: 21BSC5C5MTL
Total Contact Hours: 56	Course Credits: 04
Internal Assessment Marks: 40	Duration of SEE: 3 hours
Semester End Examination Marks: 60	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Carry out certain computations such as computing upper and lower Riemann sums as well 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.

DSC5: Real Analysis-II & Complex Analysis

Unit	Description	Hours
1	**Riemann Integration-I** Definition & examples for partition of an interval, refinement of a partition and common refinement. Riemann Darboux Sums - Upper and lower (Darboux) sums –definition, properties & 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.	11
2	**Riemann-Stieltjes Integral and Improper Integral:** Fundamental theorem of Calculus–related problems, change of variables, integration by parts, first and second mean value theorems of integral calculus. Riemann-Stieltjes Integral– Definition & examples. Riemann Integral as a special case. Improper Integral-Improper integrals of the first, second and third kind with examples. Improper integral has the limit of the proper integral. Comparison test, Abel's test and Dirichlet's test for the convergence of the integral of a product of two functions.	11
3	**Complex numbers and functions of complex variables:** Complex numbers-Cartesian and polar form-geometrical representation-complex-PlaneEuler's formula- e i = cos + isin. Functions of a complex variable-limit, continuity and differentiability of a complex function. Analytic	12

	function, Cauchy-Riemann equations in Cartesian and Polar forms- Sufficiency conditions for analyticity(Cartesian form only)- Harmonic function-standard properties of analytic functions-construction of analytic function when real or imaginary part is given-Milne Thomson method.	
4	**Transformations and Complex integration:** Transformations: Definition- Jacobian of a transformation- Identity transformationReflection- Translation- Rotation- Stretching- Inversion- Linear transformation- DefinitionsBilinear transformations- Cross-ratio of four points- Cross-ratio preserving propertyPreservation of the family of straight lines and circles- Conformal mappings- Discussion of the transformations $w = z^2$, $w = \sin z$, $w = e^z$, $w = z + 2\bar{z}$.	11
5	**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.	11

References:

1. S.C Malik, Real Analysis, New Age International (India) Pvt. Ltd.
2. S.C.Malik and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd.
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, 3 rd Edition, McGraw 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, 2 nd Edition, Alpha Science International Limited.
10. R.V. Churchil& J.W. Brown, Complex Variables and Applications, 5th ed, McGraw Hill Companies.

Date Course Coordinator Subject Committee Chairperson

DSC5 Lab: Practical's on Real Analysis-II & Complex Analysis

Course Title: Practical's on Real Analysis-II & Complex Analysis	Course code: 21BSC5C5MTP
Total Contact Hours: 56	Course Credits: 02
Internal Assessment Marks: 25	Duration of SEE: 3 hours
Semester End Examination Marks: 25	

Course Outcomes (CO's):

At the end of the course, students will be able 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.

DSC5 Lab: Practical's on Real Analysis-II & Complex Analysis

Unit	Description	Hours
1	**Programs using Scilab/Maxima/Python:** 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 Program to check whether a function is harmonic or not 8 Program to construct analytic functions (through Milne–Thompson method). 9 Program to find Cross ratio of points and related aspects. 10 Program to find fixed points of bilinear transformations. 11 Program to verify De Moivre's theorem.	56
References: 1. S.C Malik, Real Analysis, New Age International (India) Pvt. Ltd. 2. S.C.Malik and Savita Arora, Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd. 3. Richard R Goldberg, Methods of Real Analysis, Oxford and IBH Publishing.		

Date Course Coordinator Subject Committee Chairperson

DSC6: Vector Calculus and Analytical Geometry

Course Title: Vector Calculus and Analytical Geometry	Course code: 21BSC5C6MTL
Total Contact Hours: 56	Course Credits: 04
Internal Assessment Marks: 40	Duration of SEE: 3 hours
Semester End Examination Marks: 60	

Course Outcomes (CO's):

At the end of the course, students will be able to: This course will enable the students to

1. Get introduced to the fundamentals of vector differential and integral calculus.
2. Get familiar with the various differential operators and their properties.
3. Get acquainted with the various techniques of vector integration.
4. Learn the applications of vector calculus.
5. Recollect the fundamentals of Analytical Geometry in 3D.
6. Interpret the geometricalaspects of planes and lines in 3D.

DSC6: Vector Calculus and Analytical Geometry

Unit	Description	Hours
1	**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; Curvature and Torsion of a space curve-definitions, derivation and problems, Serret-Frenet formulae.	07
2	**Scalar field** 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.	07
3	**Vector Integration** Definition and basic properties, vector line integral, surface integral and volume integral; Green's theorem in the plane – Proof and related problems, Direct consequences of the theorem; Gauss' Divergence theorem – Proof and related problems, Direct consequences of the theorem; Stokes' theorem – Proof and related problems, Direct consequences of the theorem.	14
4	**Analytical Geometry:** Planes, Straight Lines and Spheres Planes: Distance of a point from a plane, Angle between two planes, pair of planes, Bisectors of angles between two planes; Straight lines: Equations of straight lines, Distance of	14

	a point from a straight line, Distance between two straight lines, Distance between a straight line and a plane;	
5	**Spheres:** Different forms, Intersection of two spheres, Orthogonal intersection, Tangents and normal, Radical plane, Radical line, Coaxial system of spheres, Pole, Polar and Conjugacy. Locus, Surfaces, Curves and Conicoids Space curves, Algebraic curves, Ruled surfaces, Some standard surfaces, Classification of quadric surfaces, Cone, Cylinder, Central conicoids, Tangent plane, Normal, Polar planes, and Polar lines.	14

References:

1. Robert J. T. Bell (1994). An Elementary Treatise on Coordinate Geometry of Three Dimensions. Macmillan India Ltd.
2. D. Chatterjee (2009). Analytical Geometry: Two and Three Dimensions. Narosa Publishing House.
3. Shanthi Narayan and P. K. Mittal, Analytical Solid Geometry, S. Chand Publications.
4. A. N. Das, Analytical Geometry of Two and Three Dimensions, New Central Book Agency Pvt. Ltd.
5. M. D. Raisinghania, Vector Calculus, S Chand Co. Pvt. Ltd., 2013.
6. M. Spiegel, Vector Analysis, 2 nd Edition, Schaum's Outline Series, Mc-Graw Hill, Education, 2017.
7. C. E. Weatherburn, Elementary Vector Analysis, Alpha edition, 2019.
8. P. N. Wartikar and J. N. Wartikar, A Textbook of Applied Mathematics, Vol. II, Pune Vidyarthi GrihaPrakashan, Pune, 2009.
9. C. E. Weatherburn, Differential Geometry of Three Dimension, Khosla Publishing House, 2020.
10. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
11. G. B. Thomas and R. L. Finney, Introduction to Calculus and Analytical Geometry, Narosa Publishing House, 2010.

Date Course Coordinator Subject Committee Chairperson

DSC6 Lab: Practical's on Vector Calculus and Analytical Geometry

Course Title: Practical's on Vector Calculus and Analytical Geometry	Course code: 21BSC5C6MTP
Total Contact Hours: 56	Course Credits: 02
Internal Assessment Marks: 25	Duration of SEE: 3 hours
Semester End Examination Marks: 25	

Course Outcomes (CO's):

At the end of the course, students will be able to: 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.

DSC6 Lab: Practical's on Vector Calculus and Analytical Geometry

Unit	Description	Hours
1	**Practical/Lab Work to be performed in Computer Lab (FOSS)** **Suggested Software:** Maxima/Scilab /Python/R. **Suggested Programs:** 1. Program on multiple product of vectors – Scalar and Cross product. 2. Program on vector differentiation and finding unit tangent 3. Program to find curvature and torsion of a space curve. 4. Program to find the gradient and Laplacian of a scalar function, divergence and curl of a vector function. 5. Program to demonstrate the physical interpretation of gradient, divergence and curl. 6. Program to evaluate a vector line integral. 7. Program to evaluate a surface integral. 8. Program to evaluate a volume integral. 9. Program to verify Green's theorem. 10. Program to find equation and plot sphere, cone and cylinder. 11. Program to find distance between a straight line and a plane. 12. Program to construct and plot some standard surfaces.	56

References:

1. Robert J. T. Bell (1994). An Elementary Treatise on Coordinate Geometry of Three Dimensions. Macmillan India Ltd.
2. D. Chatterjee (2009). Analytical Geometry: Two and Three Dimensions. Narosa Publishing House.
3. Shanthi Narayan and P. K. Mittal, Analytical Solid Geometry, S. Chand Publications.
4. A. N. Das, Analytical Geometry of Two and Three Dimensions, New Central Book Agency Pvt. Ltd.
5. M. D. Raisinghania, Vector Calculus, S Chand Co. Pvt. Ltd., 2013.

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