MAHARAJA GANGA SINGH UNIVERSITY, BIKANER

Syllabus

Choice Based Credit System (CBCS)

BA/BSc (SEMESTER SCHEME)

Mathematics

Semester-I exam Dec2025

Semester-II exam June2026

Semester-III exam Dec2026

Semester-IV exam June2027

Semester-V exam Dec2027

Semester-VI exam June2028

SCHEME OF EXAMINATION AND COURSE OF STUDY

Semester	Course Code	Course Name	Code	L	T	P	Total Credits	Maximum Marks			Minimum Pass marks* 36%
								Internal	External	Total	
I	MAT4.5DCCT 1	Algebra	DCC	9	0	0	6	30	120	150	11/43
II	MAT4.5DCCT 2	Calculus	DCC	9	0	0	6	30	120	150	11/43
III	MAT5.0DCCT3	Higher Calculus	DCC	9	0	0	6	30	120	150	11/43
V	MAT5.0DCCT 4	Differential Equations	DCC	9	0	0	6	30	120	150	11/43
V	MAT5.5DCCT 5	Ring Theory and Vector Spaces	DCC	9	0	0	6	30	120	150	11/43
VI	MAT5.5DCCT 6	Analysis	DCC	9	0	0	6	30	120	150	11/43

*For a pass, a candidate is required to obtain 36% marks in Internal assessment and external examination(End of semester exam) separately.

Internal assessment is a continuous assessment throughout the semester and the marks shall be given on the basis of class room activities, class test/assignment submission, seminar and viva-voice.

Course pattern(End of Semester exam)

A course is divided into 5 units and a question paper has 3 sections .

Section A (20 marks) shall contain 10 questions two from each Unit. Each question shall be of 2 marks. All the questions are compulsory. Section A will be prepared such that questions i through v are multiple-choice questions, while questions vi through x will be fill-in-the-blank questions.

Section B (40 marks) shall contain 5 questions (two from each unit with internal choice). Each question shall be of 8 marks. The candidate is required to answer all 5 questions. The answers should not exceed 200 words.

Section C (60 marks) shall contain 5 questions, one from each Unit. Each question shall be of 20 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 500 words.

टिप्पणी – आंतरिक मूल्यांकन पूरे सेमेस्टर के दौरान एक सतत मूल्यांकन है और अंक कक्षा गतिविधियों, कक्षा परीक्षा / असाइनमेंट प्रस्तुति, सेमिनार और वाइवा वॉयस के आधार पर दिए जाएंगे।

पाठ्यक्रम पैटर्न प्रत्येक कोर्स को 5 इकाइयों मे विभाजित किया गया है तथा प्रश्न पत्र मे 3 खंड है

- **खंड अ** (20 अंक) प्रत्येक इकाई से दो प्रश्नों को सम्मिलित करते हुए कुल 10 प्रश्न होंगे। प्रत्येक प्रश्न 2 अंकों का होगा। सभी प्रश्न अनिवार्य है। प्रश्न संख्या पसे अ वस्तुनिष्ट तथा अप से ग रिक्त स्थान पूर्ति के प्रकार के होंगे।
- **खंड ब** (40 अंक) इस खंड मे 5 प्रश्न होंगे (आंतरिक विकल्प के साथ प्रत्येक इकाई से 2 प्रश्न)। सभी 5 प्रश्न अनिवार्य है। प्रत्येक प्रश्न 8 अंकों का होगा। प्रत्येक प्रश्न का उत्तर 200 शब्दों से अधिक नहीं होना चाहिए।
- **खंड स** (60 अंक) इस खंड मे प्रत्येक इकाई से 1 प्रश्न को सम्मिलित करते हुए कुल 5 प्रश्न होंगे। इनमे से कोई 3 प्रश्न हल करने है। प्रत्येक प्रश्न 20 अंकों का होगा। प्रत्येक प्रश्न का उत्तर 500 शब्दों से अधिक नहीं होनो चाहिए।

B.A./B.Sc. Semester I

Course Code	Course Name	Code	L	T	P	Total Credits	Maximum Marks			Minimum Pass marks 36%
							Internal	External	Total	
MAT4.5DCCT1	Algebra	DCC	9	0	0	6	30	120	150	11/43

Note : The paper is assigned 9 teaching hours per week.

MAT4.5DCCT 1

Duration- 3 hours   Maximum marks- 120

Course objective: Students will learn from the course:

- Relation between roots and coefficients of polynomial equation of one variable.
- Solution of cubic equation, bi-quadratic equation.
- Matrices, its rank, linear independence of its rows and column, Cayley's Hamilton theorem.
- Algebraic structure Group, its definition, properties, different types of groups, subgroups and Cosets.
- Homomorphism, Isomorphism of groups, Normal subgroup, Quotient group, kernel of homomorphism.

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

- Answer about the nature of roots of polynomial equation.
- Solve cubic and biquadratic equation.

- Apply matrix theory to find the consistency of system of linear equation and solution of it.
- Appreciate ample types of groups present around us which explains our surrounding better, and classify them as abelian, cyclic and permutation groups.
- Explain the significance of the notion of cosets, normal subgroups and homomorphisms.

Algebra

Unit - I

Relation between roots and coefficients of general polynomial equation in one variable, transformation of equations, Descartes' rule of signs, Solution of Cubic equations (Cardono's Method) Biquadratic Equations (Ferrari Method).

Unit - II

Symmetric, Skew symmetric. Hermitian and skew Hermitian matrices. Linear Independence of row and column matrices. Row rank, Column rank, Rank of a matrix by Echelon form, the characteristic equation of a matrix and eigenvectors. Cayley Hamilton theorem and its use in finding inverse of a matrix. Applications of matrices to a system of linear (both homogenous and non-homogenous) equations. Theorems of consistency of a system of linear equations.

Unit - III

Definitions and examples of groups, general properties of groups, subgroups, cyclic groups, cosets decomposition, Lagrange's theorem and its consequences, Fermat's and Euler's theorems.

Unit - IV

Homomorphism and isomorphism of groups, normal subgroups, quotient groups. The fundamental theorem of homomorphism. Kernel of homomorphism and its properties.

Unit - V

Permutations groups, even, odd and cyclic permutations, transpositions, the alternating group-An , Conjugacy, and simple groups. Cayley's theorem. Order of an element of a group and its properties.

MAT4.5DCCT 1

अवधि 3 घंटे   अधिकतम अंक 120

बीज गणित

इकाई—1

एक चर वाली व्यापक बहुपदीय समीकरण के मूलों तथा गुणांको में संबंध, समीकरण रूपान्तरण, डीकार्टेज चिन्ह नियम, त्रिघात समीकरण का हल (कार्डन विधि), चर्तुघात समीकरण का हल (फेरारी विधि)

इकाई–2

सममित, विषम सममित, हार्मिशियन तथा विषममहार्मिशियन मैट्रिसेज, पंक्ति तथा स्तंभ मैट्रिसेज का एक घात स्वतन्त्रता, पंक्ति जाति, स्तंभ जाति इचेलॉन फॉर्म द्वारा मैट्रिक्स की जाति आइगन मान, आइगन संदिश तथा मैट्रिक्स की अभिलक्षणिक समीकरण, केली हेमिल्टन प्रमेय तथा मैट्रिक्स के प्रतिलोम ज्ञात करने में प्रयोग, समीकरण के रैखिक निकाय (समघात एवं असमघात) मेंमैट्रिक्स का प्रयोग, सरल समीकरण निकाय की संगतता के प्रमेय।

इकाई–3

ग्रुप की परिभाषाएं उदाहरण तथा व्यापक प्रगुणए उपग्रुप, चक्रीय ग्रुप, सह–समुच्चय, विभक्तिकरण, लाग्रान्जप्रमेय और उसके निगमन, फरमेट्स तथा आयलर प्रमेय।

इकाई–4

ग्रुपों में समाकारिता व तुल्यकारिता, विशिष्ट उपग्रूप वं विभाग ग्रुप, समाकारिता का मूल प्रमेय, समाकारिता की अष्टि और उसके प्रगुण।

इकाई–5

कमचय ग्रुप, सम, विषम व चक्रीय क्रमचय, पक्षान्तरण,, एकान्तरग्रुप , संयुग्मिता, सरलग्रुप, कैली प्रमेय, ग्रुप के अवयवों की कोटि तथा उसके प्रगुण।

REFERENCE BOOKS:

1. Chandrika Prasad :The Text Book of Algebra and Theory of Equations, Pothishala Pvt Ltd. Allahabad.
2. Vashitha, A.R.: Modern Algebra, Krishna Prakashan Mandir, Meerut
3. Gokhroo et. Al.: Group Theory (English/Hindi Ed.) Navkar Prakashan, Ajmer.
4. P.B. Bhattacharya and Others: Basic Abstract Algebra (2nd Edition) Camb. University Press Indian Edition,1997
5. Herstein I. N.: Topics in Algebra Wiley Eastern Ltd. New Delhi (1975)
6. Bansal, Bhargava & Agarwal: Abstract Algebra, Jaipur Publishing House, Jaipur.

B.A./B.Sc. Semester II

Course Code	Course Name	Code	L	T	P	Total Credits	Maximum Marks			Minimum Pass marks 36%
							Internal	External	Total	
MAT4.5DCCT2	Calculus	DCC	9	0	0	6	30	120	150	11/43(36%)

Note : The paper is assigned 9 teaching hours per week.

MAT4.5DCCT 2

Duration- 3 hours   Maximum marks- 120

Course objective: The aim of this course is to introduce the learners the concept of:

- Differential calculus: Application of differentiation to find the geometric properties of a curve such as curvature, asymptotes, singular points, stationary points and curve tracing.
  Differentiation for the function of several variables.
- Integral calculus: Calculation of the length of plane curves, volume and surface area of solid of revolution with the help of integration.
  Beta-Gamma functions and multiple integrals.

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

- Find Partial derivatives, total derivatives of the given functions of two or more variables.
- Apply the concepts to find minimum and maximum values of functions.
- Understand the concepts of Curvature and derive Formulae for curvature.
- Understand the concept of asymptote.
- Find the nature of the function by tracing it.
- Calculate the length of plane curves, Volume and Surfaces area of solid of Revolution.
- Determine Beta and Gamma functions.
- Determine double and triple integrals.
- Perform differentiation and integration under the sign of integration.

Calculus

Unit – I

Pedal equation of a curve, Envelope and Evolutes, Asymptotes, Curvature: Various Formulae, Centre of curvature, chord of curvature and related problems.

Unit - II

Partial differentiation, chain of variables, Euler's theorem on homogeneous functions, first two differential coefficients of an implicit functions. Taylor's theorem for functions of two variables, Jacobians with properties.

Unit - III

Maximum – Minimum and saddle points of functions of two and three variables connected by a relation. Lagrange's method of undermined multipliers. Test of concavity and convexity, points of inflexion, multiple points, curve tracing in Cartesian and polar coordinates (standard curves).

Unit - IV

Differentiation and Integration under the sign of integration, Beta and Gamma functions, double integrals, change of order of integration, transformation in polar coordinates.

Unit - V

Quadrature, rectification, volume and surface of solid of revolution. Triple integrals.
Dirichlet's integrals and Liouville's extension.

MAT4.5DCCT 2
अवधि 3 घंटे   अधिकतम अंक 120

कलन

इकाई—1
वक्र की पादिक समीकरण अन्वा लोप तथा केन्द्रज, अनन्त स्पर्शियों, वक्रता व संबंधित सूत्र , वक्रता
केन्द्र वक्रता जीवा और उनसे संबंधित प्रश्न।

इकाई—2
आंशिक अवकलन चरों की कड़ियॉं, सम घातफलनों का आयलर प्रमेय, अस्प ट फलनों के
प्रथम—द्वितीय अवकलन गुणांक।दो चरों वाले फलनों का टेलर प्रमेय।जकाबियन व उसके गुण धर्म।

इकाई—3
दो व तीन चरों वाले फलनों के उच्चिष्ठ, निम्नि ठ एवं पल्याण बिन्दु अनिधार्य गुणांकों की लाग्रान्ज
विधि। उत्तलता एवं अवतलता, नति परिवर्तन बिन्दु एव ंबहुल बिन्दु हेतु परिक्षण।वक्र अनुरेखण धुर्वीय
व कार्तिय निर्देशांकों में (आदर्श वक्रों का)।

इकाई—4
समाकलन चिन्ह के अन्तर्गत अवकलन व समाकलन, बीटा व गामाकलन : द्विसमाकलन ज्ञात
करना।समाकलन के क्रम में परिवर्तन करना एवं ध्रुवीय निर्देशांकों में परिवर्तन करना।

इकाई—5
क्षेत्रफल, चॉपकलन, परिक्रमण से प्राप्त ठोसों के आयतन एवं पृष्ठ, त्रिसमाकलन, डिरिचलेट समाकलन
और उसका लिवेली व्यापकीकरण।

REFERENCE BOOKS:

1. Gorakh Prasad: Text Book of Differential calculus, Pothishala Pvt. Ltd., Allahabad
2. Gorakh Prasad: Text Book of Integral calculus, Pothishala Pvt. Ltd., Allahabad
3. Piskunov N.: Differential and Integral calculus, Peace Publications, Moscow
4. Gokhroo et. al.: Differential Calculus (English/Hindi Ed.) Navkar Prakashan, Ajmer.
5. Gokhroo et. al.: Integral Calculus (English/Hindi Ed.) Navkar Prakashan, Ajmer.
6. Erwin Kreyszig: Advance Engineering Mathematics John Willey and sons 1999.

B.A./B.Sc. Semester III

Course Code	Course Name	Code	L	T	P	Total Credits	Maximum Marks			Minimum Pass marks 36%
							Internal	External	Total	
MAT5.0DCCT3	Higher Calculus	DCC	9	0	0	6	30	120	150	11/43

Note : The paper is assigned 9 teaching hours per week.

 MAT5.0DCCT3

Duration- 3 hours   Maximum marks- 120

Course objective: Students will be introduced to the:

- Concept of convergence of sequence, series and improper integral.
- Concept of uniform convergence as an extension of convergence of sequence and series.
- Riemann integral and its properties.
- Improper integral and its convergence.

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

- have strong foundation in basic concepts of Real Analysis which will enrich them to have a good knowledge in Pure Mathematics.
- Take advanced level courses in Real Analysis and Topology.
- Carry out a rigorous analysis of calculus of functions of a real variable.
- Write, in a logical manner, important theorems, its proof and properties of continuous, differentiable and integrable functions.

Higher Calculus

Unit - I

Limit ε-δ definition of the limit of a function, Limit of functions of one and two variables, Continuity, classification of discontinuities, Sequential continuity, Properties of continuous functions, Uniform continuity, Continuity of functions of two variables.

Unit - II

Differentiability, Chain rule of differentiability, Differentiability of functions of two variables, Darboux's intermediate value theorem for derivatives, Mean Value Theorems and their geometrical interpretations, Taylor's theorem with various forms of remainders, Taylor's theorem for functions of two variables.

Unit - III

Riemann integral, Partition, Darboux sums, Lower and Upper integrals, Integrability of continuous and monotonic functions. the fundamental theorem of Integral Calculus, Mean value theorems of Integral Calculus.

Unit - IV

Real sequence, definition, Theorems on limits of sequences, Bounded and monotonic sequences, Cauchy's convergence criterion.

Infinite Series of non-negative terms, Comparison tests, Cauchy's n^{th} root test, Ratio tests, Raabe's, logarithmic, De Morgan and Bertrand's tests Alternating series, Leibniz theorem, Absolute and conditional convergence.

Unit – V

Uniform convergence of series of functions, Weierstrass M-test, Abel's and Dirichlet's test for uniform convergence. Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests, Fourier Series, Fourier expansion of piecewise monotonic functions.

MAT5.0DCCT3

अवधि 3 घंटे अधिकतम अंक 120

उच्चतर कलन

इकाई–1
सीमा $\varepsilon.\delta$ सीमा की परिभाषा, एक तथा दो चरों के फलनों की सीमा, सांतत्यता, असांतत्यता का वर्गीकरण, अनुक्रमीय सांतत्यता, संतत फलनों के प्रगुण, एकसमान सांतत्यता, दो चरों वाले फलनों की सांतत्यता।

इकाई–2
अवकलनीयता, अवकलनीयता का श्रृंखला नियम, दो चरों वाले फलनों की अवकलनीयता, अवकलज केडॉबू मध्यवर्ती मान प्रमेय, मध्यमान प्रमेय तथा उनका ज्यामितीय अर्थ, विभिन्न प्रकार के शेषफल वाला टेलर प्रमेय, दो चरों वाले फलनों का टेलर प्रमेय।

इकाई–3
रीमान समाकलन, विभाजन, डॉर्बू योग, निचला तथा ऊपरी समाकल, संतत तथा एकदिष्ट फलनों की समाकलनीयता, समाकल गणित का मूल प्रमेय, समाकल गणित के मध्यमान प्रमेय।

इकाई–4
वास्तविक अनुक्रम, परिभाषा, वास्तविक अनुक्रम की सीमा संबंधी प्रमेय, परिबद्ध तथा एकदिष्ट अनुक्रम, कोषी अभिसरण कसौटी, अऋणात्मक पदों वाली अनन्त श्रेणियाँ, तुलना परीक्षण, कोशी परीक्षण, अनुपात परीक्षण, रेबी, लघुगुणक तथा डिमार्गन परीक्षण, एकान्तर श्रेणी, लेबनीज प्रमेय, निरपेक्ष तथा सशर्त अभिसरण।

इकाई–5
फलनों की श्रेणी का एकसमान अभिसरण, एकसमान अभिसरण के लिए वाईस्ट्रास एम परीक्षण, ऐबल तथा डिरिचलिट परीक्षण, अनन्त समाकल तथा उनका अभिसरण, तुलना परीक्षण, ऐबल तथा डिरिचलिट परीक्षण, फूरिए श्रेणी, एकदिष्ट फलनों के फूरिए प्रसार।

REFERENCE BOOKS:

1. Real Analysis: Shanti Narayan
2. Real Analysis: G. N. Purohit
3. Real Analysis : Bhargava & Goyal
4. Advanced Calculus: Gokhroo et. al. (English / Hindi Ed.)
5. Theory of Convergence: Gokhroo et. al. (English / Hindi Ed.) Navkar Prakashan, AJMER.

B.A./B.Sc. Semester IV

Course Code	Course Name	Code	L	T	P	Total Credits	Maximum Marks			Minimum Pass marks 36%
							Internal	External	Total	
MAT5.0DCC4	Differential Equations	DCC	9	0	0	6	30	120	150	11/43

Note : The paper is assigned 9 teaching hours per week.

MAT5.0DCCT 4

Duration- 3 hours   Maximum marks- 120

Course objective: Students will be introduced to the concept of ordinary and partial differential equations and their solutions.

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

- Solve first order and first-degree, first order and higher degree ODE(ordinary differential equation).
- Solve linear differential equation with constant coefficients, Homogeneous differential equation, simultaneous differential equation and total differential equation.
- Solve linear differential equation of second order.
- Solve the differential equation problems using power series method.
- Understand and solve partial differential equation of first and higher order.
- Classify linear PDE of second order.

Differential Equations

Unit - I

Degree and order of differential equations, Equations of first order and first degree, Equations in which the variables are separable, Homogeneous equations, Linear equations and equations reducible to the linear form, Exact differential equations, Integrating Factors, First order and higher degree equations solvable for x, y, p, Clairaut's form and Singular solutions, Geometrical meaning of a differential equation, Orthogonal trajectories.

Unit - II

Linear differential equations with constant coefficients, Homogeneous Linear ordinary differential equations, Ordinary simultaneous differential equations, Total differential equations.

Unit - III

Linear differential equations of Second order, Transformation of the equation by changing dependent variable/the independent variable. Methods of variation of parameters.

Series solution of differential equations, Power series method, Bessel, Legendre and Hyper geometric equations, Bessel, Legendre and Hyper geometric functions and their properties.

Unit - IV

Partial differential equations of the first order, Lagrange's solution, some special type of equations which can be solved easily by methods other than the general method, Charpit's general method of solution.

Unit - V

Partial Differential equations of second order and higher orders, Classification of linear Partial differential equations of second order, Homogeneous and non-homogeneous equations with constant coefficients, Partial differential equations reducible to equations with constant coefficients, Monge's methods.

MAT5.0DCCT 4

अवधि 3 घंटे अधिकतम अंक 120

अवकल समीकरण

इकाई—1
अवकल समीकरण का क्रम तथा घात, प्रथम श्रेणी तथा प्रथम घात के अवकल समीकरण, चर प्रथक्करण, समघात समीकरण, रैखिक समीकरण तथा रैखिक समीकरण में समानीत समीकरण, यथार्थ अवकल समीकरण, समाकल खण्ड, x, y, p के लिए हल वाले प्रथम क्रम तथा उच्च घात के समीकरण, क्लारेट रूप, विचित्र हल, अवकल समीकरण का ज्यामिति अर्थ, लम्बकोणीय संछेदी।

इकाई—2
अचर गुणांक वाले रैखिक समीकरण, रैखिक समघात समीकरण, साधारण युगपत अवकल समीकरण, पूर्ण अवकल समीकरण।

इकाई—3
द्वितीय क्रम के रैखिक अवकल समीकरण, आश्रित चर, स्वतंत्र चर को बदल कर समीकरण का रूपांतरण, प्राचल वितरण विधि, अवकल समीकरण का श्रेणी हल, घात श्रेणी विधि, बेसल, लेजान्ड्रे तथा हायपरज्यामितीय समीकरण, बेसल, लेजान्ड्रे तथा हायपरज्यामितीय फलन हल तथा प्रगुण।

इकाई—4
प्रथम क्रम के आंशिक अवकल समीकरण, लाग्रांज हल, व्यापक विधि के अतिरिक्त अन्य विधियों से हल होने वाली विशेष प्रकार की समीकरण, हल हेतु चारपीट व्यापक विधि।

इकाई—5
द्वितीय तथा उच्च क्रम के आंशिक अवकल समीकरण, द्वितीय क्रम के रैखिक आंशिक अवकल समीकरणों का वर्गीकरण, अचर गुणांकों वाले समघात तथा असमघात समीकरण, अचर गुणांक वाले आंशिक अवकल समीकरणों में समानीत समीकरण, मोंगे विधि।

REFERENCE BOOKS:

1. Ray and Chaturvedi: Differential Equations.
2. Sharma and Gupta: Differential Equations.

3. Bansal and others: Differential Equations.
4. Gokhroo et. al.: Ordinary Differential Equations, (English / Hindi Ed.).
5. Gokhroo et.al.: Partial Differential Equations, (English / Hindi Ed.) Navkar Prakashan, Ajmer.

B.A./B.Sc. Semester V

Course Code	Course Name	Code	L	T	P	Total Credits	Maximum Marks			Minimum Pass marks 36%
							Internal	External	Total	
MAT5.5DCCT5	Ring Theory and Vector Spaces	DCC	9	0	0	6	30	120	150	11/43

Note : The paper is assigned 9 teaching hours per week.

MAT5.5DCCT 5

Duration- 3 hours   Maximum marks- 120

Course objective: Students will learn from the course:

- Algebraic structure ring, integral domain, field and their properties.
- Ring morphism, embedding of a ring and field of quotient.
- Ideals and its types.
- Explore the concepts of unique factorization domain, Euclidean ring, polynomial rings and polynomial over rational field.
- Vector space, its properties and examples, basis, dimension and vector space homomorphism(linear transformation).
- Matrix representation, rank-nullity theorem, dual space.
- Eigen values and eigen vector, similar matrices and diagonalization of matrices.

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

- Understand the fundamental concept of rings, integral domains, fields and vector space.
- Know about ring homomorphisms and isomorphisms theorems of rings.
- Construct quotient fields for integral domains.
- Appreciate the significance of unique factorization in integral domains.
- Define and analyze linear transformations between vector spaces.
- Compute the matrix of linear transformation

- Understand the concepts of eigenvalues, eigenvectors, rank, nullity, invertibility of matrices and Diagonalization of matrix.

Ring Theory and Vector Spaces

Unit - I

Introduction to Rings, Zero divisors, Integral Domain and Fields, their examples and properties. Characteristic of a ring and integral domain. Sub rings, subfields, Prime field, Ring homomorphism, Embedding of Rings, Field of quotients of an integral domain.

Unit- II

Ideals and their properties. Principal ideal and principal ideal ring, Prime ideal, Maximal ideal. Ideals and Quotient rings, Euclidean rings, Unique Factorization Domain, Polynomial rings, Polynomials over the rational fields.

Unit - III

Vector space definition and examples, subspaces, sum and direct sum of subspaces, linear span, linear dependence, Independence and their basic properties, Basis, dimension, finite dimensional vector spaces, Existence theorem for basis, invariance of the number of elements of a basis set, Dimension of a subspace, complimentary subspace, quotient space and its dimension.

Unit - IV

Linear Transformations and their representation as matrices, the algebra of linear transformations, the Rank-Nullity theorem, change of basis, Dual space, Dual Basis.

Unit - V

Eigen values and Eigen vectors, similar matrices, equivalent matrices, Similarity of Linear transformations, Reduction to triangular form, Minimal Polynomial, Diagonalization of Matrices.

MAT5.5DCCT 5

अवधि 3 घंटे अधिकतम अंक 120

रिंग सिद्धांत व सदिश समष्टि

इकाई—1
रिंग परिचय , शून्य भाजक, पूर्णांकिय प्रांत, क्षेत्र के उदाहरण व प्रगुण, रिंग व पूर्णांकिय प्रांत का अभिलक्षण, उपरिंग, उपक्षेत्र, अभाज्य क्षेत्र, रिंग समाकारिता, रिंग का अंतरूस्थापन, विभाग क्षेत्र।

इकाई—2
गुणजावली व उसके प्रगुण, मुख्य गुणजावली, मुख्य गुणजावली रिंग, अभाज्य गुणजावली, उच्चिष्ठ गुणजावली, विभाग रिंग, यूक्लिडीअन रिंग, अद्विती गुणनखंडनय प्रांत, बहुपद रिंग, परिमय क्षेत्र पर बहुपद।

इकाई—3
सदिश समष्टि परिभाषा तथा उदाहरण, उपसमष्टि, उपसमष्टि का योग तथा सीधा योग, रैखिक विस्तृति, रैखिक आश्रितता, स्वतंत्रता तथा उनके मूल गुण, आधार, विमा, परिमित विमिय सदिश समष्टि,

अस्तित्वता प्रमेय, आधार समुच्चय में अवयवों की संख्या में समानता, उपसमष्टि तथा उसकी विमा, पूरक उपसमष्टि, विभाग समष्टि तथा उसकी विमा।

इकाई—4

रैखिक रूपान्तरण एवं उनका मैट्रिक्स निरूपण, रैखिक रूपान्तरण का बीजगणित, समष्टि समाकारिता, रैखिक रूपान्तरण की कोटि तथा शून्यता, सिल्वेस्टर का शून्यता का नियम, आधार का परिवर्तन, द्वैती समष्टि, द्वैती आधार।

इकाई—5

आइगेन मान तथा आइगेन सदिश, समान मैट्रिसेज, तुल्य मैट्रिसेज, रैखिक रूपान्तरण की समरूपता, मैट्रिक्स का त्रिभुजीय रूप में समनयन, न्यूनतम बहुपद, मैट्रिक्स का विकर्णीकरण।

REFERENCE BOOKS:

1. I.N. Herstein: Topics in Algebra
2. Lang, S.: Linear Algebra
3. Hoffman & Kunz: Linear Algebra
4. A.R. Vasishta : Modern Algebra
5. Gokhroo et. al.: Ring Theory (English / Hindi Ed.)
6. Gokhroo et. al.: Linear Algebra (English / Hindi Ed.)

B.A./B.Sc. Semester VI

Course Code	Course Name	Code	L	T	P	Total Credits	Maximum Marks			Minimum Pass marks 36%
							Internal	External	Total	
MAT5.5DCCT6	Analysis	DCC	9	0	0	6	30	120	150	11/43

Note : The paper is assigned 9 teaching hours per week.

MAT5.5DCCT 6

Duration- 3 hours   Maximum marks- 120

Course objective: Students will learn from the course:

- Axioms of the real numbers, supremum, infimum, open and closed sets in R, compactness, connectedness, the Bolzano-Weierstrass, Heine-Borel Theorems.
- About Metric spaces, its properties, convergence, continuity, uniform continuity, completeness and denseness.
- About complex numbers and their geometrical representation.
- About the concept of limit, continuity, differentiability and analytic functions.
- Concept of conformal mapping, it's necessary and sufficient condition, bilinear transformation and some elementary transformation.

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

- Have a strong foundation in basic concepts of Analysis which will enrich their knowledge in Pure Mathematics.

- Appreciate how the concept of distance is taken to define an abstract space (Metric space)
- Concepts of Continuity, Connectedness and Compactness in metric space.
- Understands curves and region in the complex plane, stereographic projection, Complex valued functions.
- Evaluate limits, Convergence, continuity, Differentiability in the extended plane,
- Understands analytic functions, Cauchy-Reimann equations and its application.
- Understands conformal mapping, its necessary and sufficient condition, bilinear mapping.
- Understands and sketch complex valued functions.

Analysis

Unit - I

Real Number System as a complete Ordered Field. The point set theory, Open and Closed sets, Limit point of a set, Neighborhood, Bolzano-Weierstrass theorem, Heine-Borel theorem, Compactness, connectedness, Cantor's ternary set.

Unit - II

Definition and example of a metric space, Diameter of a set, Bounded set, Open sphere, Interior point and Interior of a set, Closed set, Closed Sphere, Derived and Closure of set, Properties of Open and Closed sets, Boundary point of set, Convergent and Cauchy sequences, complete metric space, Cantor's Intersection theorem. Dense subset, Baire Category theorem.

Unit - III

Limit of a function, Continuous function, theorem on necessary and sufficient conditions for continuity of a function, Uniform continuity, Contracting mapping, Banach Fixed Point theorem, Equivalent metric spaces, Compactness, sequentially compactness, Totally Bounded space, Finite Intersection properties.

Unit - IV

Complex Numbers as ordered pairs, Complex plane, Geometrical representation, Connected and compact sets, Curves and region in the complex plane, Statement of Jordan curves theorem, Extended complex plane and stereographic projection, Complex valued functions limits, Convergence, continuity, Differentiability in the extended plane, Analytic functions. Cauchy-Reimann equations (Cartesian & Polar forms).

Unit - V

Harmonic functions, Construction of conjugate function, conformal mapping, Necessary and sufficient conditions for conformal mapping, Elementary mapping, Fixed point, Inverse point, Bilinear transformation, Transformations: $w = 1/2\,(z+1/z)$, $w = z^2$, $w = 2z$, $w = \sin z$, $w = \cos z$ and $w = \exp z$.

MAT5.5DCCT 6

अवधि 3 घंटे अधिकतम अंक 120

विश्लेषण

इकाई—1

वास्तविक संख्या निकाय का पूर्ण क्रमिक क्षेत्र वाला रूप, बिन्दु समुच्चय सिद्धांत, विवृत एवं संवृत समुच्चय, समुच्चय का सीमा बिन्दु, प्रतिवेश, व्युत्पन्न, बॉलजानों बाईस्ट्रास प्रमेय, हैनीबोरेल प्रमेय, सहंतताए संबद्धता, कैन्टर टर्नरी समुच्चय।

इकाई—2

दूरीक समष्टियाँ, परिभाषा एवं उदाहरण, समुच्चय का व्यास, परिबद्ध समुच्चय, विवृत गोला (गेंद) आंतरिक बिन्दु,
आंतरिक समुच्चय। संवृत समुच्चय, संवृत गोला, व्युत्पन्न एवं संवरक समुच्चय । विवृत एवं संवृत समुच्चयों के गुणधर्म। समुच्चय का सीमांत बिन्दु। अभिसारी एवं कॉशी अनुक्रम। पूर्ण दूरिक समष्टि। केंटर सर्वनिष्ठ प्रमेय, संघन उपसमुच्चय, बेयर श्रेणी प्रमेय।

इकाई—3

फलन की सीमा, संतत फलन, फलनों की सांतत्यता के लिए आवश्यक एवं पर्याप्त प्रतिबंध, एक समान संतततता, संक्षिप्त (कार्ट्रेक्टिंग) प्रतिचित्रण, बानाक स्थिर बिन्दु प्रमेय, तुल्य दूरिक समष्टि सहंतता, अनुक्रमशः संहत, पूर्ण परिबद्ध समष्टि, परिमित सर्वनिष्ठता गुणधर्म।

इकाई—4

क्रमित युग्म के रूप में सम्मिश्र संख्याएँ, सम्मिश्र समतल, सम्मिश्र राशियों का ज्यामिति निरूपण, संबद्ध तथा संहत समुच्चय, सम्मिश्र तल में वक्र तथा क्षेत्र, जार्डन कर्व प्रमेय का कथन, विस्तारित सम्मिश्र तल तथा त्रिविम प्रक्षेप, सम्मिश्र चरों के सम्मिश्र फलनों की सीमा, सांतत्यता, अवकलनीयता, विश्लेषिक फलन, कॉशी रीमन समीकरण (कार्तिय एवं ध्रुवीय रूप)।

इकाई—5

प्रसंवादी फलन, संयुग्मी फलन का निर्धारण, अनुकोण प्रतिचित्रण, प्रतिकोण प्रतिचित्रण के लिए आवश्यक एवं पर्याप्त प्रतिबंध, प्रारंभिक प्रतिचित्रण, निसचर बिन्दुए प्रतिलोम बिन्दए द्विरेखिक रूपांतरणें, ,रूपांतरणः $w = 1/2 \ (z+1/z)$, $w = z^2$, $w = 2z$, $w = \sin z$, $w = \cos z$ तथा $w = \exp z$ ।

REFERENCE BOOKS:

1. Shanti Narain: Complex Variables, S. Chand, New Delhi.
2. Gupta, KP: Complex Analysis
3. Sharma J.N.: Metric Spaces, Krishna Prakashan Mandir, Meerut.
4. Gokhroo et.al.: Metric Spaces (English / Hindi Ed.)
5. Gokhroo et.al.: Complex Analysis (English / Hindi Ed.) Navkar, Publications, Ajmer.