MAHARSHI DAYANAND UNIVERSITY ROHTAK

(Established under Haryana Act No. XXV of 1975)

'A+' Grade University accredited by NAAC

NOTICE FOR INVITING SUGGESTIONS/COMMENTS ON THE DRAFT SYLLABI OF B.A, B.SC., B.COM. UNDER CBCS

Comments/suggestions are invited from all the stakeholders i.e Deans of the Faculties, HODs, Faculties and Principals of Affiliated Colleges on the Syllabi and Scheme of Examinations of B.A, B.Sc., B.Com. Programmes under CBCS (copy enclosed) through e-mail to the Dean, Academic Affairs upto 15.09.2020, so that the same may be incorporated in the final draft.

Dean Academic Affairs

B.A. Program

Program Specific Objectives:

i) To impart conceptual and theoretical knowledge of Mathematics and its various tools/techniques.

ii) To equip with analytic and problem solving techniques to deal with the problems related to diversified fields.

Program Specific Outcomes. Student would be able to:

i) Acquire analytical and logical thinking through various mathematical tools and techniques and attain in-depth knowledge to pursue higher studies and ability to conduct research.

ii) Achieve targets of successfully clearing various examinations/interviews for placements in teaching, banks, industries and various other organisations/services.

B.A Pass Course under Choice Based Credit System
Department of Mathematics

Proposed Scheme of Examination

SEMESTE	COURSE OPTED	COURSE NAME	Credits	Marks	Internal Assessment	Total Marks
I	Ability Enhancement Compulsory Course-I	(English/ Hindi/ MIL Communication)/ Environmental Science	4	80	20	100
	Core Course-I DSC 1A	English/ Hindi/ MIL	6 (5+1)	120	30	150
	Core Course-II (Theory) DSC 2A	Calculus	4	80	20	100
	Core Course-II (Practical) DSC 2A	Calculus	2	50	-	50
	Core Course-III DSC 3A	DSC 3A	6 (5+1)	120	30	150
II	Ability Enhancement Compulsory Course-II	Environmental Science/ (English/ Hindi/ MIL Communication	4	80	20	100
	Core Course-IV DSC 1B	English/ Hindi/ MIL	6 (5+1)	120	30	150
	Core Course-V (Theory) DSC 2B	Algebra	4	80	20	100
	Core Course-V (Practical) DSC 2B	Algebra	2	50	--	50
	Core Course-VI DSC 3B	DSC 3B	6 (5+1)	120	30	150
III	Skill Enhancement Course -1 SEC-1	Programming in C and Numerical Methods	4	80	20	100
	Core Course-VII DSC 1C	English/ Hindi/ MIL	6 (5+1)	120	30	150
	Core Course-VIII (Theory) DSC 2C	Differential Equations	4	80	20	100
	Core Course-VIII (Practical) DSC 2C	Differential Equations	2	50	--	50
	Core Course-IX DSC 3C	DSC 3C	6(5+1)	120	30	150
IV	Skill Enhancement Course -2 SEC-2	Probability and Statistics	4	80	20	100
	Core course-X DSC 1D	English/ Hindi/ MIL	6 (5+1)	120	30	150
	Core Course-XI (Theory) DSC 2D	Real Analysis	4	80	20	100

	Core Course-XI (Practical) DSC 2D	Real Analysis	2	50	--	50
	Core Course-XII DSC 3D	DSC 3D	6 (5+1)	120	30	150
V	Skill Enhancement Course -3 SEC-3	Statistical Techniques	4	80	20	100
	Generic Elective -1 GE-1	Vedic Mathematics / Elementary Mathematics	6 (5+1)	120	30	150
	Discipline Specific Elective -1(Theory) DSE-1	Mathematics	4	80	20	100
	Discipline Specific Elective – 1 (Practical) DSE-1	Mathematics	2	50	--	50
	Discipline Specific Elective – 2 DSE-2	DSE-2	6(5+1)	120	30	150
VI	Skill Enhancement Course -4 SEC-4	Discrete Mathematics	4	80	20	100
	Generic Elective – 2 GE-2	Mathematical Techniques/ Applicable Mathematics	6 (5+1)	120	30	150
	Discipline Specific Elective -3 (Theory) DSE-3	Mathematics	4	80	20	100
	Discipline Specific Elective – 3 (Practical) DSE-3	Mathematics	2	50	--	50
	Discipline Specific Elective – 4 DSE-4	DSE-4	6 (5+1)	120	30	150

A. CORE COURSES

1. Calculus + Practical
2. Algebra+ Practical
3. Differential Equations + Practical
4. Real Analysis + Practical

B. DISCIPLINE SPECIFIC ELECTIVE COURSES

a) Discipline Specific Elective-2 (Fifth Semester)
(Select any one of three options)

1. Mechanics (4)+ Practical Based on Mechanics (2)
2. Numerical Analysis (4)+ Practical Based on Numerical Analysis (2)
3. Number Theory and Trigonometry (4)+ Practical Based on Number Theory and Trigonometry (2)

b) Discipline Specific Elective-4 (Sixth Semester)
(Select any one of three options)

1. Linear Algebra (4)+ Practical Based on Linear Algebra (2)
2. Special Functions and Integral Transforms (4)+ Practical Based on Special Functions and Integral Transforms (2)
3. Vector Calculus and Differential Geometry (4)+ Practical Based on Vector Calculus and Differential Geometry (2)

C. GENERIC ELECTIVE COURSES

a) Generic Elective-1 (Fifth Semester)
(Select any one of the two options)

1. Vedic Mathematics
2. Elementary Mathematics

b) Generic Elective-2 (Sixth Semester)
(Select any one of the two options)

1. Mathematical Techniques
2. Applicable Mathematics

D. SKILL ENHANCEMENT COURSES

1. Programming in C and Numerical Methods
2. Probability and Statistics
3. Statistical Techniques
4. Discrete Mathematics

Core Course-II (Theory)

Calculus

Credits : 4

(Theory: 4 hours/ 6 pds per Week)

Max. Marks (T) : 80

Internal Marks (T) : 20

Learning Objectives.

i) To introduce the basic concept of continuous functions, their properties and applications.

ii) To explain the limit, continuity and differentiability of real valued functions, their partial derivatives and total derivatives.

iii) To obtain Asymptotes and curvature for curves.

iv) To apply the concepts of calculus for tracing of curves.

Course Learning Outcomes: The course will enable the students to

i) Learn conceptual variations while advancing from one variable to several variables in calculus.

ii) Apply multivariable calculus in optimization problems.

iii) Calculate the limit and examine the continuity of a function at a point.

iv) Sketch curves in Cartesian and polar coordinate systems.

Note. The question paper will consist of five sections. Each of the first four sections (*I-IV*) will contain two questions and the students shall be asked to attempt one question from each section. Section-V will contain Eight short answer type questions without any internal choice covering the entire syllabus and shall be compulsory.

Section – I

Limit and Continuity ($\varepsilon - \delta$ definition), Discontinuity and its types, Differentiability of the functions, Successive differentiation, Leibnitz rule and its applications, L' Hospital's rule: Indeterminate forms. Taylor's theorem with Lagrange's and Cauchy's forms of remainders, Maclaurin's and Taylor's series expansions.

Section – II

Tangent and Normal, Asymptotes of Curves in Cartesian and polar co-ordinates, Curvature, Radius of Curvature for Cartesian curves, parametric, polar and pedal form of curves, Circle of Curvature, Chord of Curvature. Concavity, Convexity and Inflexion points.

Section – III

Tracing of curves in Cartesian, parametric and polar co-ordinates of Standard curves (Cubic curves, Semicubical Parabola, Folium of Descartes, Cardioid, Lemniscate of Bernoulli, Astroid, Rose curve, Logarithmic Spiral, Epispiral, Cycloid, Catenary).

Section – IV

Functions of Several Variables, Limits and Continuity, Partial Differentiation and Euler's theorem on homogenous functions, Chain rule. Maxima, Minima and saddle points of two variables. Lagrange's method of multipliers.

Books Recommended:

1. Anton, H., Birens, I. and Davis, S. (2002). Calculus. John Wiley and Sons, Inc.
2. Courant, R. and John, F. (1989). Introduction to Calculus and Analysis (Volume I and II). Springer-Verlag, New York, Inc.
3. Piskunov, N. (1969). Differential and integral Calculus. Peace Publishers, Moscow.
4. Spiegel, M. R. (1963)., Theory and Problems of Advanced Calculus. Schaum's Outline series. Schaum Publishing Co., New York.
5. Strauss, M. J., Bradley, G. L. and Smith, K. J. (2007). Calculus (3rd edition) Dorling Kindersley (India) P Ltd (Pearson Education), Delhi.
6. Thomas, G.B and Finney, R.L. (2005). Calculus (9th edition). Pearson Education Delhi.

Core Course-II (Practical)

Calculus

Credits : 2

(Practical: 4 hours/ 6 pds per Week)

Max. Marks (P) : 50

Learning Objectives.

i) To give idea of graphs of various functions and tracing of curves.
ii) To understand asymptotes with the help of graphs.
iii) To study various graphical transformations.
iv) To design tables of various trigonometric functions.

Course Learning Outcomes: The course will enable the students to

i) Solve and calculate the mathematical problems graphically.
ii) Have a clear idea of asymptotes for a curve.
iii) Understand the effect of various transformation applied to functions.
iv) Sketch curves in Cartesian and polar coordinate systems.

Note. The question paper will consist of 8 practicals (4 Practicals from PART A and 4 Practicals from PART B). The students shall be asked to attempt 4 practicals (2 from PART A and 2 from PART B)

List of Practicals (using any software)

PART A

1. Plotting of graphs of following functions (i) $y = x^n$, Rational function (ii) $f(x) = \frac{1}{x^n}$ Irrational function (iii) $f(x) = x^{1/n}$ where $n \in N$ (discuss both cases on n for even or odd) (iv) Piecewise Function (Modulus function, Signum function, Greatest integer function, Fractional part function, Least integer function).
2. Plotting of graphs of following transcendental and standard functions (i) Sin(x), Cos(x), Tan(x), Cot(x), Sec(x), Cosec(x), $e^x, a^x(a > 1, a < 1)$, $log_a(x)$ (a>1, a<1) and Standard Geometrical functions (i) Straight Line (ii) Circle (iii) Parabola (iv) Ellipse (v) Hyperbola.
3. (i) Plotting of graphs of six inverse trigonometric functions and hyperbolic functions (ii) Solution of Transcendental equation using graph for example $sinx = \frac{x}{10}$, cos(x)=x (iii) Plotting of graphs of functions $sin^{-1}(sinx)$, $sin(sin^{-1}x)$.
4. Study of Concavity, Convexity and point of inflexion using graph (i) $f(x) = (x - \alpha)(x - \beta)$ (ii) $f(x) = (x - \alpha)(x - \beta)(x - \gamma)$ (iii) $f(x) = |x - \alpha|(x - \beta)$ (iv) $f(x) = \frac{x+1}{x^2+3}$.
5. Plotting of graphs of the function $sin(ax + b)$, $cos(ax + b)$, $sinh(ax + b)$, $cosh(ax + b)$ for various values of a and b.
6. Plotting of graphs of the function e^{ax+b}, $log(ax + b)$, $\frac{c}{ax+b}$, c^{ax+b} for various values of a, b and c.
7. Sketching parametric curves (E.g. Trochoid, Cycloid , Epicycloids, Hypocycloid).
8. Determine Asymptotes in Curve using graphs (i) $y = \frac{1}{x-3}$ (ii) y=tanx (iii) $y = e^{1/x}$ (iv) $y = x + 1/x$ (v) $y = \frac{x^2+2x-1}{x}$.

PART B

1. Study of various graphical transformations by which $f(x)$ transform to $f(x) \mp a$, $f(x \mp a)$, $af(x), f(ax), |f(x)|, f(|x|), |f(|x|)|, |y| = f(x), |y| = |f(x)|$, $|y| = |f(|x|)|$, $y = [f(x)], y = f([x]), y = [f([x])]$.
2. Form the table for Sine function, Cosine function for $0^o, 1^o, 2^o, \ldots, 90^o$ using Maclaurin's series expansion.
3. Plotting the graphs of polynomials of degree 2, 3, 4 and 5, the derivative graph , second derivative graph and comparing them.
4. Trace the curves (i) $y^2(a^2 + x^2) = x^2(a^2 - x^2)$ (ii) $a^2y^2 = a^2x^4 - x^6$ (iii) $9ay^2 = (x - 2a)(x - 5a)^2$ (iv) $x^2 = (y - 1)(y - 2)(y - 3)$.
5. Trace the curves (i) $x^2y^2 = x^2 + 1$ (ii) $y = \frac{x+1}{x^3}$ (iii) $x^2y^2 = a^2(y^2 - x^2)$.
6. Sketching parametric curves (E.g. Trochoid, Cycloid , Epicycloids, Hypocycloid, Catenary).
7. Trace the curves (i) $y^2(a^2 + x^2) = x^2(a^2 - x^2)$ (ii) $a^2y^2 = a^2x^4 - x^6$ (iii) $9ay^2 = (x - 2a)(x - 5a)^2$ (iv) $x^2 = (y - 1)(y - 2)(y - 3)$.
8. Trace the curves (i) $x^2y^2 = x^2 + 1$ (ii) $y = \frac{x+1}{x^3}$ (iii) $x^2y^2 = a^2(y^2 - x^2)$.
9. Sketching Polar Curves (Cardioid, Astroid, Rose Curve, Logarthmic sprial).

Books Recommended:

1. Anton, H., Birens, I. and Davis, S. (2002). Calculus. John Wiley and Sons, Inc.
2. Courant, R. and John, F. (1989). Introduction to Calculus and Analysis (Volume I andII). Springer-Verlag, New York, Inc.
3. Piskunov, N. (1969). Differential and integral Calculus. Peace Publishers, Moscow.
4. Spiegel, M. R. (1963)., Theory and Problems of Advanced Calculus. Schaum's Outline series. Schaum Publishing Co., New York.
5. Strauss, M. J., Bradley, G. L. and Smith, K. J. (2007). Calculus (3rd edition) Dorling Kindersley (India) P Ltd (Pearson Education), Delhi.
6. Thomas, G.B and Finney, R.L. (2005). Calculus (9th edition). Pearson Education Delhi.

Core Course-V (Theory)

Algebra

Credits : 4

(Theory: 4 hours/ 6 pds per Week)

Max. Marks (T) : 80

Internal Marks (T) : 20

Learning Objectives.

- i) To introduce the concept of matrix and type of matrices. explain the concept of Eigen values, Eigen functions, minimal polynomials of matrices and the applications of matrices to a system of linear equations.
- ii) To introduce the students with the study of algebraic structures, such as group, subgroup, normal subgroup, cyclic subgroup, rings, fields etc.
- iii) To explain the relations of orders of a group and subgroup, centralizer and normalizer of a subgroup.
- iv) To understand the concepts of integral domains and characteristic of an integral domain.

Course Learning Outcomes: The course will enable the students to

- i) Recognize the mathematical objects called groups and link the fundamental concepts of groups and symmetries of geometrical objects.
- ii) Explain the significance of the notions of cosets, normal subgroups, and factor groups.
- iii) Understand consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank. Find eigenvalues and corresponding eigenvectors for a square matrix**.**
- iv) Differentiate between ideals and subrings.

Note. The question paper will consist of five sections. Each of the first four sections (*I-IV*) will contain two questions and the students shall be asked to attempt one question from each section. Section-V will contain Eight short answer type questions without any internal choice covering the entire syllabus and shall be compulsory.

Section – I

Matrix and its types. Symmetric, Skew-symmetric, Hermitian and Skew Hermitian matrices. Unitary and Orthogonal Matrices, Idempotent, Involuntary, Nilpotent Matrices.

Rank of a Matrix and its Applications. Rank of a matrices, Row rank and column rank of a matrix, Elementary Operations on matrices, Inverse of a matrix , Normal Form, PAQ Form, Linear dependence and independence of rows and columns of matrices , Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations, Theorems on consistency of a system of linear equations.

Cayley Hamilton theorem. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix. Diagonalization of matrix.

Section – II

Group Theory. Binary operations. Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GL(n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle and (iv) a square. Group of quarternions. Subgroups, order of an element, Cyclic group and their properties, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group.

Section – III

Group Theory (Continued). Permutation group, Cosets, Index of subgroup, Lagrange's theorem, Normal subgroups: their definition, examples with C(H) and N(H) and characterizations. Quotient groups.

Section – IV

Ring Theory. Definition and examples of rings, examples of commutative and non-commutative rings. Rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains. Fields, examples of fields: Z_p, Q, R and C. Field of rational functions, Characteristic of a ring

Books Recommended:

1. Andrews, G. E. (2012). Number Theory, Dover Publications.
2. Artin, M. (2014). Abstract Algebra (2nd Edition). Pearson.
3. Fraleigh, J. B. (2007). A First Course in Abstract Algebra (7th Edition). Pearson.
4. Friedberg, S. H., Insel, A. L. and Spence, L. E. (2004). Linear Algebra (4th Edition). Prentice Hall of India Pvt. Ltd., New Delhi.
5. Gallian, J. A. (2017). Contemporary Abstract Algebra (9th edition). Cengage.
6. Herstein, I. N. (2006). Topics in Algebra (2nd edition). Wiley India.

Core Course -V (Practical)

Algebra

Credits : 2

(Practical: 4 hours/ 6 pds per Week)

Max. Marks (P) : 50

Learning Objectives.

i) To understand the applications of matrices in various fields.
ii) To explain the order of groups and the elements of group.
iii) To obtain the composition tables for the group of symmetries.
iv) To know about the order of various groups of units.

Course Learning Outcomes: The course will enable the students to

i) Use matrices in applications of computer graphics and to obtain codes.
ii) Understand the relation of order of various elements of a group.
iii) Obtain nilpotent, idempotent and unit elements in Z_n.
iv) Determine the centralizer and normalizer of subgroups using softwares.

Note. The question paper will consist of 8 practicals (4 Practicals from PART A and 4 Practicals from PART B. The students shall be asked to attempt 4 practicals (2 from PART A and 2 from PART B)

List of Practicals (using any software)

Part-A

1. Determine the (i) size of U(n) form n= 2,4,8,16,32,64,129: Make a conjecture about the size of $U(2^k)$ (ii) size of U(n) form n= 3,9,27,81,5,25,125,625: Make a conjecture about the size of $U(p^k)$ where p is odd prime (iii) size of U(n) form n= 6,12,18,10,50,250: Make a conjecture about the size of $U(2p^k)$ where p is odd prime (iv) size of U(n) form n= 15,20, 40, 100,108: Make a conjecture about the size of $U(p^k q^s)$ where p and q are is distinct prime.
2. Determine the inverse of every element in U(n) form when n from 2 to 27.
3. Composition Tables for groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square.
4. Determine order of each element in U(18), U(12), U(20), U(8), Z_{20}, Z_{18}, D_{10}, D_{12}, Q_4
5. Determine the Size of $GL(2, Z_2)$ and $GL(2, Z_3)$, order of every element and inverse of each element.
6. List the Subgroups of groups U(18), U(12), U(20), U(8), Z_{20}, Z_{18}, D_{10}, D_{12}, Q_4 also check whether it is cyclic subgroup or not.
7. Determine which of the following groups are cyclic U(18), U(12), U(20), U(8), Z_{20}, Z_{18}, D_{10}, D_{12}, Q_4.
8. Find subgroup C(a) for (i) (123) in group S_6 , (ii) $(12)(34)$ in group S_6 (iii) $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$ in group GL(2,R) (iv) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ in group GL(2,R). Also find $Z(GL(2, R))$.
9. Find all the left and right cosets of following subgroups of S_4 and also find $C(H), N(H)$. Also check whether H is normal subgroups or not: (i) $H = \{(1), (12)\}$ (ii) $H = \{(1), (12)(34)\}$ (iii) $H = \{(1), (12), (34), (12)(34)\}$ (iv) H=<(1234)> (v) $H = A_4$.
10. If H in the above experiment is normal subgroup, then form the composition table for $\frac{S_4}{H}$.

Part-B

1. Find the number of idempotent, nilpotent and unit elements in ring Zn for many values of n.
2. Find all the sub rings of ring Z_{18}, Z_{24} . Also which of the sub rings are ideals or not.

3. Practical based on System of Homogenous Equation and application to solve balance chemical equation.
4. Practical based on System of Non- Homogenous Equation and applications to solve network flow problems, Nutrition and Economic Input-Output Models.
5. Problems based Markov process a type of Mathematical Modeling .
6. Applications and Uses of Matrix in Coding theory.
7. Study of reflection, shear, dilation, contraction of figure using matrix transformation as application of computer graphics.
8. Application of System of Equations to Solve Electric Circuits.
9. Applications of Eigen values to solve a Diffusion Process and Dynamical Systems.

Books Recommended:

1. Artin, M. (2014). Abstract Algebra (2^{nd} Edition). Pearson.
2. DeFranza, J. and Gagliardi, D. (2009). Introduction to Linear Algebra with Applications, McGraw Hill Education (India) Pvt Ltd, New Delhi.
3. Friedberg, S. H., Insel, A. L. and Spence, L. E. (2004). Linear Algebra (4^{th} Edition). Prentice Hall of India Pvt. Ltd., New Delhi.
4. Gallian, J. A. (2017). Contemporary Abstract Algebra (9th edition). Cengage.
5. Herstein, I. N. (2006). Topics in Algebra (2^{nd} edition). Wiley India.
6. Kolman, B., Hill, D. R. (2005). Introductory Linear Algebra An Applied First Course (8^{th} Edition). Prentice Hall.

B.Sc. Pass Course

Program Specific Objectives:

i) To impart conceptual and theoretical knowledge of Mathematics and its various tools/techniques.

ii) To equip with analytic and problem solving techniques to deal with the problems related to diversified fields.

Program Specific Outcomes. Student would be able to:

i) Acquire analytical and logical thinking through various mathematical tools and techniques and attain in-depth knowledge to pursue higher studies and ability to conduct research.

ii) Achieve targets of successfully clearing various examinations/interviews for placements in teaching, banks, industries and various other organisations/services.

B.Sc. Pass Course under Choice Based Credit System
Department of Mathematics

Proposed Scheme of Examination

SEMESTER	COURSE OPTED	COURSE NAME	Credits	Marks	Internal Assessment	Total Marks
I	Ability Enhancement Compulsory Course-I	(English/ Hindi/MIL Communication)/ Environmental Science	4	80	20	100
	Core Course-I (Theory) DSC 1A	Calculus	4	80	20	100
	Core Course-I (Practical) DSC 1A	Calculus	2	50	-	50
	Core Course-II DSC 2A	DSC 2A	6 (4+2)/ (5+1)	-	-	150
	Core Course-III DSC 3A	DSC 3A	6	-	-	150
II	Ability Enhancement Compulsory Course-II	Environmental Science/ (English/ Hindi/ MIL Communication)	4	80	20	100
	Core course-IV (Theory) DSC 1B	Algebra	4	80	20	100
	Core Course-IV (Practical) DSC 1B	Algebra	2	50	-	50
	Core course-V DSC 2B	DSC 2B	6 (4+2)/ (5+1)	-	-	150
	Core Course-VI DSC 3B	DSC 3B	6	-	-	150
III	Skill Enhancement Course -1	Programming in C and Numerical Methods	4	80	20	100
	Core Course-VII (Theory) DSC 1C	Differential Equations	4	80	20	100
	Core Course-VII (Practical) DSC 1C	Differential Equations	2	50	-	50
	Core Course-VIII DSC 2C	DSC 2C	6 (4+2)/ (5+1)	-	-	150
	Core Course-IX DSC 3C	DSC 3C	6	-	-	150
IV	Skill Enhancement Course -2 SEC-2	Probability and Statistics	4	80	20	100

	Core Course-X (Theory) DSC 1D	Real Analysis	4	80	20	100
	Core Course-X (Practical) DSC 1D	Real Analysis	2	50	-	50
	Core Course-XI DSC 2D	DSC 3D	6 (4+2)/ (5+1)	-	-	150
	Core Course-XII DSC 3D	DSC 3D	6	-	-	150
V	Skill Enhancement Course -3	Statistical Techniques	4	80	20	100
	Discipline Specific Elective -1(Theory) DSE-1A	Mathematics	4	80	20	100
	Discipline Specific Elective -1 (Practical) DSE-1A	Mathematics	2	50	-	50
	Discipline Specific Elective -2 DSE-2A	DSE-2A	6	-	-	150
	Discipline Specific Elective -3 DSE-3A	DSE-3A	6	-	-	150
VI	Skill Enhancement Course -4 SEC-4	Discrete Mathematics	4	80	20	100
	Discipline Specific Elective -4 (Theory) DSE-1B	Mathematics	4	80	20	100
	Discipline Specific Elective -4 (Practical) DSE-1B	Mathematics	2	50	-	50
	Discipline Specific Elective - 5 DSE-2B	DSE-2B	6	-	-	150
	Discipline Specific Elective - 6 DSE-3B	DSE-3B	6	-	-	150

A. CORE COURSES

1. Calculus + Practical
2. Algebra + Practical
3. Differential Equations + Practical
4. Real Analysis + Practical

B. DISCIPLINE SPECIFIC ELECTIVE CORUSES

a) Discipline Specific Elective-3 (Fifth Semester)

(Select any one of the three options)

1. Mechanics (4)+ Practical Based on Mechanics (2)
2. Numerical Analysis (4)+ Practical Based on Numerical Analysis (2)
3. Number Theory and Trigonometry (4)+ Practical Based on Number Theory and Trigonometry (2)

b) Discipline Specific Elective-6 (Sixth Semester)

(Select any one of the three options)

1. Linear Algebra (4)+ Practical Based on Linear Algebra (2)
2. Special Functions and Integral Transforms (4)+ Practical Based on Special Functions and Integral Transforms (2)
3. Vector Calculus and Differential Geometry (4)+ Practical Based on Vector Calculus and Differential Geometry (2)

C. SKILL ENHANCEMENT COURSES

1. Programming in C and Numerical Methods
2. Probability and Statistics
3. Statistical Techniques
4. Discrete Mathematics

Core Course-I (Theory)

Calculus

Credits : 4

(Theory: 4 hours/ 6 pds per Week)

Max. Marks (T) : 80

Internal Marks (T) : 20

Learning Objectives.

i) To introduce the basic concept of continuous functions, their properties and applications.

ii) To explain the limit, continuity and differentiability of real valued functions, their partial derivatives and total derivatives.

iii) To obtain Asymptotes and curvature for curves.

iv) To apply the concepts of calculus for tracing of curves.

Course Learning Outcomes: The course will enable the students to

i) Learn conceptual variations while advancing from one variable to several variables in calculus.

ii) Apply multivariable calculus in optimization problems.

iii) Calculate the limit and examine the continuity of a function at a point.

iv) Sketch curves in Cartesian and polar coordinate systems.

Note. The question paper will consist of five sections. Each of the first four sections (*I-IV*) will contain two questions and the students shall be asked to attempt one question from each section. Section-V will contain Eight short answer type questions without any internal choice covering the entire syllabus and shall be compulsory.

Section – I

Limit and Continuity ($\varepsilon - \delta$ definition), Discontinuity and its types, Differentiability of the functions, Successive differentiation, Leibnitz rule and its applications, L' Hospital's rule: Indeterminate forms. Taylor's theorem with Lagrange's and Cauchy's forms of remainders, Maclaurin's and Taylor's series expansions.

Section – II

Tangent and Normal, Asymptotes of Curves in Cartesian and polar co-ordinates, Curvature, Radius of Curvature for Cartesian curves, parametric, polar and pedal form of curves, Circle of Curvature, Chord of Curvature. Concavity, Convexity and Inflexion points.

Section – III

Tracing of curves in Cartesian, parametric and polar co-ordinates of Standard curves (Cubic curves, Semicubical Parabola, Folium of Descartes, Cardioid, Lemniscate of Bernoulli, Astroid, Rose curve, Logarithmic Spiral, Epispiral, Cycloid, Catenary).

Section – IV

Functions of Several Variables, Limits and Continuity, Partial Differentiation and Euler's theorem on homogenous functions, Chain rule. Maxima, Minima and saddle points of two variables. Lagrange's method of multipliers.

Books Recommended:

1. Anton, H., Birens, I. and Davis, S. (2002). Calculus. John Wiley and Sons, Inc.
2. Courant, R. and John, F. (1989). Introduction to Calculus and Analysis (Volume I andII). Springer-Verlag, New York, Inc.
3. Piskunov, N. (1969). Differential and integral Calculus. Peace Publishers, Moscow.
4. Spiegel, M. R. (1963)., Theory and Problems of Advanced Calculus. Schaum's Outline series. Schaum Publishing Co., New York.
5. Strauss, M. J., Bradley, G. L. and Smith, K. J. (2007). Calculus (3^{rd} edition) Dorling Kindersley (India) P Ltd (Pearson Education), Delhi.
6. Thomas, G.B and Finney, R.L. (2005). Calculus (9^{th} edition). Pearson Education Delhi.

Core Course-I (Practical)

Calculus

Credits : 2

(Practical: 4 hours/ 6 pds per Week)

Max. Marks (P) : 50

Learning Objectives.

i) To give idea of graphs of various functions and tracing of curves.
ii) To understand asymptotes with the help of graphs.
iii) To study various graphical transformations.
iv) To design tables of various trigonometric functions.

Course Learning Outcomes: The course will enable the students to

i) Solve and calculate the mathematical problems graphically.
ii) Have a clear idea of asymptotes for a curve.
iii) Understand the effect of various transformation applied to functions.
iv) Sketch curves in Cartesian and polar coordinate systems.

Note. The question paper will consist of 8 practicals (4 Practicals from PART A and 4 Practicals from PART B). The students shall be asked to attempt 4 practicals (2 from PART A and 2 from PART B)

List of Practicals (using any software)

PART A

1. Plotting of graphs of following functions (i) $y = x^n$, Rational function (ii) $f(x) = \frac{1}{x^n}$ Irrational function (iii) $f(x) = x^{1/n}$ where $n \in N$ (discuss both cases for n is even or odd) (iv) Piecewise Function (Modulus function, Signum function, Greatest integer function, Fractional part function, Least integer function).
2. Plotting of graphs of following transcendental and standard functions (i) Sin(x), Cos(x), Tan(x), Cot(x), Sec(x), Cosec(x), $e^x, a^x (a > 1, a < 1)$, $log_a(x)$ (a>1, a<1) and Standard Geometrical functions (i) Straight Line (ii) Circle (iii) Parabola (iv) Ellipse (v) Hyperbola.
3. (i) Plotting of graphs of six inverse trigonometric functions and hyperbolic functions (ii) Solution of Transcendental equation using graph for example $sinx = \frac{x}{10}$, cos(x)=x (iii) Plotting of graphs of functions $sin^{-1}(sinx)$, $sin(sin^{-1}x)$.
4. Study of Concavity, Convexity and point of inflexion using graph (i) $f(x) = (x - \alpha)(x - \beta)$ (ii) $f(x) = (x - \alpha)(x - \beta)(x - \gamma)$ (iii) $f(x) = |x - \alpha|(x - \beta)$ (iv) $f(x) = \frac{x+1}{x^2+3}$.
5. Plotting of graphs of the function $sin(ax + b)$, $cos(ax + b)$, $sinh(ax + b)$, $cosh(ax + b)$ for various values of a and b.
6. Plotting of graphs of the function e^{ax+b}, $log(ax + b)$, $\frac{c}{ax+b}$, c^{ax+b} for various values of a, b and c.
7. Sketching parametric curves (E.g. Trochoid, Cycloid , Epicycloids, Hypocycloid).
8. Determine Asymptotes in Curve using graphs (i) $y = \frac{1}{x-3}$ (ii) y=tanx (iii) $y = e^{1/x}$ (iv) $y = x + 1/x$ (v) $y = \frac{x^2+2x-1}{x}$.

PART B

1. Study of various graphical transformations by which $f(x)$ transform to $f(x) \mp a$, $f(x \mp a)$, $af(x), f(ax), |f(x)|, f(|x|), |f(|x|)|, |\, y| = f(x), |\, y| = |f(x)|, \quad |\, y| = |f(|x|)|, \quad y = [f(x)], y = f([x]), y = [f([x])]$.
2. Form the table for Sine function, Cosine function for $0^o, 1^o, 2^o, \ldots., 90^o$ using Maclaurin's series expansion.
3. Plotting the graphs of polynomials of degree 2, 3, 4 and 5, the derivative graph , second derivative graph and comparing them.
4. Trace the curves (i) $y^2(a^2 + x^2) = x^2(a^2 - x^2)$ (ii) $a^2y^2 = a^2x^4 - x^6$ (iii) $9ay^2 = (x - 2a)(x - 5a)^2$ (iv) $x^2 = (y - 1)(y - 2)(y - 3)$.
5. Trace the curves (i) $x^2y^2 = x^2 + 1$ (ii) $y = \frac{x+1}{x^3}$ (iii) $x^2y^2 = a^2(y^2 - x^2)$.
6. Sketching parametric curves (E.g. Trochoid, Cycloid , Epicycloids, Hypocycloid, Catenary).
7. Trace the curves (i) $y^2(a^2 + x^2) = x^2(a^2 - x^2)$ (ii) $a^2y^2 = a^2x^4 - x^6$ (iii) $9ay^2 = (x - 2a)(x - 5a)^2$ (iv) $x^2 = (y - 1)(y - 2)(y - 3)$.
8. Trace the curves (i) $x^2y^2 = x^2 + 1$ (ii) $y = \frac{x+1}{x^3}$ (iii) $x^2y^2 = a^2(y^2 - x^2)$.
9. Sketching Polar Curves (Cardioid, Astroid, Rose Curve, Logarthmic sprial).

Books Recommended:

1. Anton, H., Birens, I. and Davis, S. (2002). Calculus. John Wiley and Sons, Inc.
2. Courant, R. and John, F. (1989). Introduction to Calculus and Analysis (Volume I andII). Springer-Verlag, New York, Inc.
3. Piskunov, N. (1969). Differential and integral Calculus. Peace Publishers, Moscow.
4. Spiegel, M. R. (1963)., Theory and Problems of Advanced Calculus. Schaum's Outline series. Schaum Publishing Co., New York.
5. Strauss, M. J., Bradley, G. L. and Smith, K. J. (2007). Calculus (3rd edition) Dorling Kindersley (India) P Ltd (Pearson Education), Delhi.
6. Thomas, G.B and Finney, R.L. (2005). Calculus (9th edition). Pearson Education Delhi.

Core Course-IV (Theory)

Algebra

Credits : 4

(Theory: 4 hours/ 6 pds per Week)

Max. Marks (T) : 80

Internal Marks (T) : 20

Learning Objectives.

i) To introduce the concept of matrix and type of matrices. explain the concept of Eigen values, Eigen functions, minimal polynomials of matrices and the applications of matrices to a system of linear equations.
ii) To introduce the students with the study of algebraic structures, such as group, subgroup, normal subgroup, cyclic subgroup, rings, fields etc.
iii) To explain the relations of orders of a group and subgroup, centralizer and normalizer of a subgroup.
iv) To understand the concepts of integral domains and characteristic of an integral domain.

Course Learning Outcomes: The course will enable the students to

i) Recognize the mathematical objects called groups and link the fundamental concepts of groups and symmetries of geometrical objects.
ii) Explain the significance of the notions of cosets, normal subgroups, and factor groups.
iii) Understand consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank. Find eigenvalues and corresponding eigenvectors for a square matrix**.**
iv) Differentiate between ideals and subrings.

Note. The question paper will consist of five sections. Each of the first four sections (*I-IV*) will contain two questions and the students shall be asked to attempt one question from each section. Section-V will contain Eight short answer type questions without any internal choice covering the entire syllabus and shall be compulsory.

Section – I

Matrix and its types. Symmetric, Skew-symmetric, Hermitian and Skew Hermitian matrices. Unitary and Orthogonal Matrices, Idempotent, Involuntary, Nilpotent Matrices.

Rank of a Matrix and its Applications. Rank of a matrices, Row rank and column rank of a matrix, Elementary Operations on matrices, Inverse of a matrix , Normal Form, PAQ Form, Linear dependence and independence of rows and columns of matrices , Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations, Theorems on consistency of a system of linear equations.

Cayley Hamilton theorem. Eigenvalues, eigenvectors and the characteristic equation of a matrix. Minimal polynomial of a matrix. Cayley Hamilton theorem and its use in finding the inverse of a matrix. Diagonalization of matrix.

Section – II

Group Theory. Binary operations. Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GL(n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle and (iv) a square. Group of quarternions. Subgroups, order of an element, Cyclic group and their properties, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group.

Section – III

Group Theory (Continued). Permutation group, Cosets, Index of subgroup, Lagrange's theorem, Normal subgroups: their definition, examples with C(H) and N(H) and characterizations. Quotient groups.

Section – IV

Ring Theory. Definition and examples of rings, examples of commutative and non-commutative rings. Rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains. Fields, examples of fields: Z_p, Q, R and C. Field of rational functions, Characteristic of a ring

Books Recommended:

1. Andrews, G. E. (2012). Number Theory, Dover Publications.
2. Artin, M. (2014). Abstract Algebra (2nd Edition). Pearson.
3. Fraleigh, J. B. (2007). A First Course in Abstract Algebra (7th Edition). Pearson.
4. Friedberg, S. H., Insel, A. L. and Spence, L. E. (2004). Linear Algebra (4th Edition). Prentice Hall of India Pvt. Ltd., New Delhi.
5. Gallian, J. A. (2017). Contemporary Abstract Algebra (9th edition). Cengage.
6. Herstein, I. N. (2006). Topics in Algebra (2nd edition). Wiley India.

Core Course -IV (Practical)

Algebra

Credits : 2

(Practical: 4 hours/ 6 pds per Week)

Max. Marks (P) : 50

Learning Objectives.

i) To understand the applications of matrices in various fields.
ii) To explain the order of groups and the elements of group.
iii) To obtain the composition tables for the group of symmetries.
iv) To know about the order of various groups of units.

Course Learning Outcomes: The course will enable the students to

i) Use matrices in applications of computer graphics and to obtain codes.
ii) Understand the relation of order of various elements of a group.
iii) Obtain nilpotent, idempotent and unit elements in Z_n.
iv) Determine the centralizer and normalizer of subgroups using softwares.

Note. The question paper will consist of 8 practicals (4 Practicals from PART A and 4 Practicals from PART B. The students shall be asked to attempt 4 practicals (2 from PART A and 2 from PART B)

List of Practicals (using any software)

Part-A

1. Determine the (i) size of U(n) form n= 2,4,8,16,32,64,129: Make a conjecture about the size of $\mathrm{U}(2^{\mathrm{k}})$ (ii) size of U(n) form n= 3,9,27,81,5,25,125,625: Make a conjecture about the size of $\mathrm{U}(\mathrm{p}^{\mathrm{k}})$ where p is odd prime (iii) size of U(n) form n= 6,12,18,10,50,250: Make a conjecture about the size of $\mathrm{U}(2\mathrm{p}^{\mathrm{k}})$ where p is odd prime (iv) size of U(n) form n= 15,20, 40, 100,108: Make a conjecture about the size of $\mathrm{U}(\mathrm{p}^{\mathrm{k}}\mathrm{q}^{\mathrm{s}})$ where p and q are is distinct prime.
2. Determine the inverse of every element in U(n) form when n from 2 to 27.
3. Composition Tables for groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square.
4. Determine order of each element in U(18), U(12), U(20), U(8), $\mathrm{Z}_{20}, \mathrm{Z}_{18}, \mathrm{D}_{10}, \mathrm{D}_{12}, \mathrm{Q}_4$
5. Determine the Size of $\mathrm{GL}(2, \mathrm{Z}_2)$ and $\mathrm{GL}(2, \mathrm{Z}_3)$, order of every element and inverse of each element.
6. List the Subgroups of groups U(18), U(12), U(20), U(8), $\mathrm{Z}_{20}, \mathrm{Z}_{18}, \mathrm{D}_{10}, \mathrm{D}_{12}, \mathrm{Q}_4$ also check whether it is cyclic subgroup or not.
7. Determine which of the following groups are cyclic U(18), U(12), U(20), U(8), $\mathrm{Z}_{20}, \mathrm{Z}_{18}$, $\mathrm{D}_{10}, \mathrm{D}_{12}, \mathrm{Q}_4$.
8. Find subgroup C(a) for (i) (123) in group S_6 , (ii) $(12)(34)$ in group S_6 (iii) $\begin{bmatrix}1 & 1\\ 1 & 0\end{bmatrix}$ in group GL(2,R) (iv) $\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$ in group GL(2,R). Also find $\mathrm{Z}(\mathrm{GL}(2, \mathrm{R}))$.
9. Find all the left and right cosets of following subgroups of S_4 and also find $\mathrm{C}(\mathrm{H}), \mathrm{N}(\mathrm{H})$. Also check whether H is normal subgroups or not: (i) $\mathrm{H} = \{(1), (12)\}$ (ii) $\mathrm{H} = \{(1), (12)(34)\}$ (iii) $\mathrm{H} = \{(1), (12), (34), (12)(34)\}$ (iv) H=<(1234)> (v) $\mathrm{H} = \mathrm{A}_4$.
10. If H in the above experiment is normal subgroup, then form the composition table for $\frac{\mathrm{S}_4}{\mathrm{H}}$.

Part-B

1. Find the number of idempotent, nilpotent and unit elements in ring Zn for many values of n.

2. Find all the sub rings of ring Z_{18}, Z_{24} . Also which of the sub rings are ideals or not.
3. Practical based on System of Homogenous Equation and application to solve balance chemical equation.
4. Practical based on System of Non- Homogenous Equation and applications to solve network flow problems, Nutrition and Economic Input-Output Models.
5. Problems based Markov process a type of Mathematical Modeling .
6. Applications and Uses of Matrix in Coding theory.
7. Study of reflection, shear, dilation, contraction of figure using matrix transformation as application of computer graphics.
8. Application of System of Equations to Solve Electric Circuits.
9. Applications of Eigen values to solve a Diffusion Process and Dynamical Systems.

Books Recommended:

1. Artin, M. (2014). Abstract Algebra (2^{nd} Edition). Pearson.
2. DeFranza, J. and Gagliardi, D. (2009). Introduction to Linear Algebra with Applications, McGraw Hill Education (India) Pvt Ltd, New Delhi.
3. Friedberg, S. H., Insel, A. L. and Spence, L. E. (2004). Linear Algebra (4^{th} Edition). Prentice Hall of India Pvt. Ltd., New Delhi.
4. Gallian, J. A. (2017). Contemporary Abstract Algebra (9th edition). Cengage.
5. Herstein, I. N. (2006). Topics in Algebra (2^{nd} edition). Wiley India.
6. Kolman, B., Hill, D. R. (2005). Introductory Linear Algebra An Applied First Course (8^{th} Edition). Prentice Hall.