CO-PO attainment
in
Outcome Based Education

Department of Mathematics,

Government General Degree College, Kalna-I

Program Outcome (PO)

- ❖PO1: Disciplinary knowledge
- ❖PO2: Communication Skills
- ❖PO3: Critical thinking
- ❖PO4 : Problem solving
- ❖PO5: Self-directed learning
- ❖PO6: Research-related skills
- ❖PO7: Analytical reasoning
- ❖PO8: Information/digital literacy
- ❖PO9: Lifelong learning

Course Content

Course code : BMG1CC1A/GE1
Course name : Differential Calculus

Course : BMG1CC1A

Differential Calculus (Marks : 75)

Total lecture hours: 60

Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions,Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem onhomogeneous functions. 20L

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves.Parametricrepresentation of curves and tracing of parametric curves, Polar coordinates and tracing of curvesin polar coordinates. 15L

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's formsof remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x, log(1+x), $(1+x)^n$, Maxima andMinima, Indeterminate forms. 25L

Course Outcome (CO) Paper: CC1A/GE1

Sl. No.	Course Outcome (CO)	Knowledge Level (Bloom's Level)	POs
1	**Describe** the conditions for continuity and differentiability of functions.	**L2: Understand**	**1, 3, 4, 6,7, 9**
2	**Apply** Leibniz's theorem and Euler's theorem to solve problems involving derivatives	**L3: Apply**	**1, 2, 3, 4, 6,7**
3	**Recall** the concept of curvature and how it measures the rate of change of direction of a curve.	**L1: Remember**	**1,3, 4, 5, 7,9**
4	**Analyze** the behavior of curves near singular points and explain their impact on the overall shape of the curve.Sequence.	**L4: Analyze**	**1, 3, 4, 5, 7**
5	**Understand** the significance of Rolle's theorem and the Mean Value theorem in calculus.	**L2: Understand**	**1,3, 4, 5,7,8**
6	**Develop** strategies for proving theorems and applying series expansions to functions.	**L6: Create**	**1, 3, 4, 5,7, 9**

Course Content

Course code : BMG2CC1B/GE2
Course name : Differential Equations

Total lecture hours: 60

First order exact differential equations. Integrating factors, rules to find an integrating factor.First order higher degree equations solvable for x, y, p. Methods for solving higher-orderdifferential equations. Basic theory of linear differential equations, Wronskian, and its properties.
Solving a differential equation by reducing its order. 20L

Linear homogenous equations with constant coefficients, Linear non-homogenous equations,The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differentialequations, Total differential equations. 16L

Order and degree of partial differential equations, Concept of linear and non-linear partialdifferential equations, Formation of first order partial differential equations, Linear partialdifferential equation of first order, Lagrange's method, Charpit's method. 15L

Classification of second order partial differential equations into elliptic, parabolic and hyperbolicthrough illustrations only. 9L

Course Outcome (CO) Paper: CC1B/GE2

Sl. No.	Course Outcome (CO)	Knowledge Level (Bloom's Level)	POs
1	**Comprehend** the process of finding integrating factors and how they are used to make equations exact.	**L2: Understand**	**1, 3, 4, 6,7, 9**
2	**Apply** the Wronskian to determine linear independence of solutions and solve initial value problems.	**L3: Apply**	**1, 2, 3, 4, 6,7**
3	**Apply** the method of variation of parameters to solve linear non-homogeneous equations.	**L3: Apply**	**1,3, 4, 5, 7,9**
4	**Evaluate** the correctness of the order and degree classification of given partial differential equations.	**L5: Evaluate**	**1, 3, 4, 5, 7,8**
5	**Analyze** 2nd order partial differential equations to classify them into elliptic, hyperbolic, and parabolic types.	**L4: Analyze**	**1, 3, 4, 5,7, 9**

Course Content

Course code : BMG3CC1C/GE3
Course name : Real Analysis
Marks : 75

Total lecture hours: 60

Finite and infinite sets, examples of countable and uncountable sets.Real line, bounded sets,suprema and infima, completeness property of R, Archimedean property of R, intervals.Conceptof cluster points and statement of Bolzano-Weierstrass theorem. 15L

Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy'stheorem on limits, order preservation and squeeze theorem, monotone sequences and theirconvergence (monotone convergence theorem without proof). 15L

Infinite series. Cauchy convergence criterion for series, positive term series, geometric series,comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test(Tests of Convergence without proof). Definition and examples of absolute and conditionalconvergence. 15L

Sequences and series of functions, Pointwise and uniform convergence.M_n-test, M-test,Statements of the results about uniform convergence and integrability and differentiability offunctions, Power series and radius of convergence. 15L

Course Outcome (CO) Paper: CC1C/GE3

Sl. No.	Course Outcome (CO)	Knowledge Level (Bloom's Level)	POs
1	**Understand** the Archimedean property and its implications.	**L2: Understand**	**1, 3, 4, 6,7, 9**
2	**Analyze** the convergence behavior and radius of convergence of power series.	**L4: Analyze**	**1, 3, 4, 5,7, 9**
3	**Apply** the definitions and properties of sequences to solve problems.	**L3: Apply**	**1,3, 4, 5, 7,9**
4	**Analyze** the convergence behavior of infinite series using different convergence tests.	**L4: Analyze**	**1, 3, 4, 5, 7,8**
5	**Understand** the concepts and criteria for pointwise and uniform convergence of sequence and series of functions.	**L2: Understand**	**1,2,3, 4, 5,7,8**

Course Content

Course code : BMG4CC1D/GE4

Course name : Algebra (Marks: 75)

Total Lecture Hours: 60

Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n ofintegers 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 lineargroup $GL_n(n,R)$, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle,(iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions. 20L

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and thecommutator subgroup of group, examples of subgroups including the center of a group.Cosets,Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition,examples, and characterizations, Quotient groups. 20L

Definition and examples of rings, examples of commutative and non-commutative rings: ringsfrom number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings ofmatrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integraldomains and fields, examples of fields: Z_p, Q, R, and C. Field of rational functions. 20L

Course Outcome (CO) — Paper: CC1D/GE4

Sl. No.	Course Outcome (CO)	Knowledge Level (Bloom's Level)	POs
1	**Understand** the concept of symmetries and dihedral groups in relation to geometric figures like a square.	**L2: Understand**	**1, 3, 4, 6,7, 9**
2	**Evaluate** the validity and applicability of group properties in different scenarios.	**L5: Evaluate**	**1, 2, 3, 4, 6,7**
3	**Recall** the definition and properties of subgroups.	**L1: Remember**	**1,3, 4, 5, 7,9**
4	**Understand** the concept of cyclic groups and their generators.	**L2: Understand**	**1, 3, 4, 5, 7,8**
5	**Analyze** the relationship between Lagrange's Theorem and subgroup orders in finite groups.	**L4:Analyze**	**1,2,3, 4, 5,7,8**
6	**Apply** the definitions and properties of rings, subrings, integral domains, fields, and characteristic of a ring to solve problems in ring theory.	**L3:Apply**	**1, 3, 4, 5,7, 9**

Course Content

Course code : BMG5DSE1A3
Course name : Linear Algebra
Marks : 75

Total lecture hours: 60

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors,linear span, linear independence, basis and dimension, dimension of subspaces. 20L

Linear transformations, null space, range, rank and nullity of a linear transformation, matrixrepresentation of a linear transformation, algebra of linear transformations.Dual Space, DualBasis, Double Dual, Eigen values and Eigen vectors, Characteristic Polynomial.Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinatematrix. 40L

Course Outcome (CO) Paper: DSE1A3

Sl. No.	Course Outcome (CO)	Knowledge Level (Bloom's Level)	POs
1	**Recall** the definitions of vector spaces, subspaces	**L1: Remember**	**1, 3, 4, 6,7, 9**
2	**Understand** the significance of linear independence, basis, and dimension in vector spaces and subspaces.	**L2: Understand**	**1, 2, 3, 4, 6,7**
3	**Analyze** the properties and relationships among eigenvalues, eigenvectors of matrices.	**L4:Analyze**	**1,3, 4, 5, 7,9**
4	**Evaluate** the properties and consequences of null space, range, rank, and nullity in linear transformations.	**L5: Evaluate**	**1, 3, 4, 5, 7,8**
5	**Apply** the concept of matrix representation to solve problems related to linear transformations.	**L3:Apply**	**1,2,3, 4, 5,7,8**
6	**Analyze** the properties and operations of matrix representation in linear transformations.	**L4:Analyze**	**1, 3, 4, 5,7, 9**

Course Content

Course code : BMG6DSE1B3
Course name : Linear Programming
Marks : 75

Total lecture hours: 60

Linear Programming Problems, Graphical Approach for solving some Linear Programs.ConvexSets, Supporting and Separating Hyperplanes.Theory of simplex method, optimality andunboundedness, the simplex algorithm, simplex method in tableau format, introduction toartificial variables, two-phase method, Big-M method and their comparison. 40L

Duality, formulation of the dual problem, primal- dual relationships, economic interpretation ofthe dual. 20L

Course Outcome (CO) Paper: DSE1B3

Sl. No.	Course Outcome (CO)	Knowledge Level (Bloom's Level)	POs
1	**Explain** the concept of feasible region	**L2: Understand**	**1, 3, 4, 6,7, 9**
2	**Apply** graphical method to solve simple LPPs.	**L3:Apply**	**1, 2, 3, 4, 6,7**
3	**Apply** simplex method to solve LPPs .	**L3:Apply**	**1,3, 4, 5, 7,9**
4	**Analyze** the advantages and limitations of Big-M method and Two Phase method in solving LPPs.	**L4:Analyze**	**1, 3, 4, 5, 7,8**
5	**Analyze** the primal-dual relationship and its implications in optimization.	**L4:Analyze**	**1, 3, 4, 5,7, 9**