

Programme Name	Pre-Ph.D. Course Work	Programme Code	23
Course Code	DSE704	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Advanced Applied Mathematic		

Objectives of the Course:

1. To identify the various aspects of Inventory control theory, Queuing theory, Replacement Problems its application and impact on multidisciplinary environment.
2. To provide the knowledge of differential equations (ODE and PDE) with its application.
3. To assess the detailed knowledge of numerical methods and learn Finite difference method for solution of hyperbolic, elliptic and parabolic with applications.
4. To provide the detailed knowledge of graphs, graph matrix, coloring and its properties.
5. To understand and illustrate the applications of fuzzy sets theory, Fuzzy numbers, fuzzy logic, and fuzzy relations.

UNIT-I (Total Topics -7 and Hrs-7)

Operations Research:

Linear programming problems, simplex methods, duality, Elementary queuing and inventory models, and Steady-state solutions of Markovian queuing models (M/M/1): (N/∞), (M/M/C): (∞/∞). Replacement theory, Job and sequence.

UNIT-II (Total Topics -7 and Hrs-8)

Differential Equations: First order ordinary differential equations, singular solutions, initial value problem of first order ODE, General theory of homogeneous and non-homogeneous linear ODE, Elementary PDE, equation solvable by direct integration, non-linear equations of first order, Charpit's method.

UNIT- III (Total Topics -6 and Hrs-7)

Numerical Methods: Finite difference method for elliptic, parabolic and hyperbolic problems. Stability, Consistency and convergence of finite difference scheme, Solution of system of linear equations, finite element methods for boundary value problems of ordinary and partial differential equation.

UNIT-IV (Total Topics -22 and Hrs-10)

Graph Theory: Introduction of Graph, Types of graphs, Operations on graphs, Hamiltonian paths and circuits, Directed graphs, Types of digraphs, Digraphs and binary relations, Directed paths and Connectedness, Euler Digraphs, Tree, Incidence matrix, Submatrix of A(G), Circuit matrix, Fundamental circuit matrix and rank of B, Cut-sets matrix, Path matrix and Adjacency matrix. Chromatic number, Chromatic partitioning, Chromatic polynomial, Matching's, Coverings, Four-color problem, Five-color theorem.

UNIT-V (Total Topics -26 and Hrs-11)

Fuzzy Mathematics: Crisp sets, Fuzzy sets, representation of Fuzzy sets, Basic operations on fuzzy sets, Fuzzy convex sets, α cuts, additional properties of α cuts, Decomposition theorems, Extensions principal for fuzzy sets and related theorems. Fuzzy Complements, Equilibrium of a fuzzy complement, Theorems on Fuzzy complement, characteristic Theorem for fuzzy complement, fuzzy intersection, Drastic intersection, fuzzy unions, Drastic union, theorems on t conforms, combination



UTTARANCHAL UNIVERSITY

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of operations and related theorems . Fuzzy numbers, arithmetic operations on fuzzy numbers, lattice of fuzzy numbers, fuzzy equations. Crips and fuzzy relations, Binary fuzzy relations on single set, fuzzy relations.

Course Outcomes:

CO1: Acquire a strong foundation in operation research and its application in multidisciplinary fields.

CO2: Gain a broad understanding of the different method of solving differential equations.

CO3: Acquire a suitable breadth of knowledge to provide a foundation for undertaking high level research based numerical problems.

CO4: Deep Understanding of concepts in graph theory and fuzzy set theory to create analyze mathematical models.

CO5: Demonstrate depth knowledge in chosen area of research specialization and ability to conduct independent mathematical research at professional level.

Reference Books

1. Sharma, S. D., An Introduction to Operations Research, Kedar Nath, 2020th edition.
2. Swarup, K., Gupta, P.K. and Manmohan, Operations Research, Sulthanchand, 2010.
3. Sharma, J. K., Operations Research, Theory and Applications, MACIN; 5th Edition, 2012.
4. Taha, H. A., Operations Research:An Introduction Hardcover, Pearson, 9th edition, 2010.
5. Simmons, G.F., Ordinary Differential Equation with applications and Historical notes, McGraw –Hill, 1991.
6. Ross, S.L., Differential equations, John Wiley and Sons, India, 2004., 3rd Ed.
7. Myint-U, T. and Debnath, L., Linear Partial Differential Equations for Scientists and Engineers, Springer, Indian reprint, 2006, 4th edition.
8. Abell, M. L. and Braselton J. P., Differential equations with MATHEMATICA, Elsevier Academic Press, 2004, 3rd Ed.
9. Sneddon, I., Elements of partial differential equation , McGraw –Hill, 1986.
10. Gupta S. and Dey S., Numerical Method, McGraw-Hill Education, 2015, 2nd reprint.
11. Sastry S. S., Introductory Methods of Numerical Analysis, 2012, 5th edition.
12. Iyengar S. R. K., Jain R. K., Numerical Methods, New age International, 2009.
13. Grewal B. S., Numerical Methods in Engineering and Science, Mercury Learning & Information, 2018.
14. Deo, N. S., Graph Theory, Prentice Hall India Learning Private Limited; New edition, 1979
15. Harary, F., Graph Theory, Addison-Wesley Publishing Company.
16. Zimmerman H. J., Fuzzy Set Theory and its Applications, SPRINGER (SIE), 2006
17. J. K. George and Yuan B., Fuzzy Sets and Fuzzy Logic: Theory and Applications, Pearson; 1st edition, 1995.
18. Kaufmann, A and Gupta M. M., Fuzzy Mathematical Models in Engineering and Management Science, Elsevier Science Ltd, 1988.
19. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice-Hall of India Pvt, 2006.

Programme Name	Pre-Ph.D. Course Work	Programme Code	23
Course Code	DSE701 (i)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Advanced Pure Mathematics		

Objectives of the Course:

1. To develop critical thinking by identifying, analyzing sequence of function, Riemann Integration and their applications.
2. To understand and illustrate the theory and applications of the complex analysis.
3. To improve the concept of class equation, conjugacy, normal series and composition series, quotient ring, field of quotient and factorization of polynomial ring.
4. To learn the advance knowledge of Metric spaces, topological spaces and its applications.
5. To develop the concept of measure function, Lebesgue measure sets. Riemann integration, L^p spaces and its applications.

UNIT-I (Total Topics -15 and Hrs-9)

Real Analysis: Existence of Riemann-Stieltjes integral, Conditions for R-S integrability, Properties of the R-S integral, R-S integrability of functions of a function, Integration of vector-valued functions, Rectifiable curves, Sequences and series of functions, pointwise and uniform convergence, Cauchy's criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Power series.

UNIT-II (Total Topics -12 and Hrs-8)

Complex Analysis: Complex Integration, Expansion of a complex function as power series, Taylor's and Laurent's series, Singularities and their Classifications, Residue, Cauchy Residue Theorem, Application of Residue Theorem in evaluation of proper and improper real Integrals and evaluation of sums, Conformal Mapping properties, Mobius Transformation, Elementary examples, Maximum Modulus Theorem, Mittag-Leffer Theorem.

UNIT- III (Total Topics -14 and Hrs-8)

Algebra: Class equation and conjugacy classes, Cauchy's theorem for finite abelian and non-abelian groups, Sylow's Ist, IInd and IIIrd theorems, The normal series and composition series, External and internal direct products, Ideals, Principal ideals, Quotient rings, fundamental theorem on homomorphism and isomorphism, Prime and maximal ideals, Ring of polynomials, Factorization of polynomials over a field, Factorization theorem in integral domain, Euclidean domain.

UNIT-IV (Total Topics -22 and Hrs-9)

Topology: Metric space, open sets, closed sets, convergence, completeness, continuity in metric space, elementary concept, basis for a topology, open and closed sets, interior and closure of sets, neighborhood of a point, limit points, boundary of a set, Topological space, subspace topology, Continuous functions, continuity theorem for open and closed sets, Connectedness, local connectedness, compactness, finite intersection property, uniform continuity, Bolzano-Weierstrass property, local compactness

UNIT-V (Total Topics -11 and Hrs-10)

Measure Theory: Functions of bounded variation, Lebesgue differentiation theorem, differentiation and integration, absolute continuity of functions, Measures and Outer measures, measure spaces, The L^p spaces Holder and Murkowski inequalities, completeness of L^p spaces, convergence in measure, almost uniform convergence, Egorov's theorem.

Course Outcomes:

CO1: Develop the advanced knowledge of R-S integral, convergence of sequence series of functions and uniform convergence.

CO2: Acquire the deep knowledge of complex number theory and application of complex integration.

CO3: Enhance understanding of advanced group theory and ring theory.

CO4: Demonstrate the conceptual knowledge of topological spaces and measure integration theory in pure mathematics.

CO5: Demonstrate depth knowledge in chosen area of research specialization and ability to conduct independent mathematical research at professional level.

Reference Books

1. Rudin, W., Principles of Mathematical Analysis, McGraw Hill Education, 2017, 3rd edition.
2. Knopp, K., Theory and Application of Infinite Series, Dover Publications Inc., 1990, Illustrated edition.
3. Apostol, T. M., Mathematical Analysis, narosa publishing house, 2002, 2nd edition.
4. Rudin, Real and Complex Analysis, McGraw Hill Education; 3rd edition, 2017, 3rd edition.
5. Conway, J. B., Functions of One Complex Variable I, Springer-Verlag New York, 1978.
6. Somasundaram D and Chaudhry, B., Complex Analysis, narosa publishing house, 1996.
7. Fraleigh, J. B., A first course in Abstract Algebra, narosa publishing house, 2003.
8. Herstein, I. N., Topics in Algebra, Wiley, 2006, 2nd edition.
9. Gallian, A. J., Contemporary Abstract Algebra, Narosa, 1998, 4th edition.
10. Munkres J., General Topology, Pearson, 2000, 2nd edition.
11. Kelley J. L., General Topology, Dover Publications, 2017, Reprint edition.
12. Pervin J. W., Foundation of General Topology, Academic Press, 2014.
13. Joshi K. D., Introduction to General Topology, Wiley Eastern Ltd., 1985.
14. Simmons G. F., Introduction to Topology and Modern Analysis, McGraw-Hill, 1983.
15. Barra G. D., Measure theory and integration, Halsted Press, 1981.
16. Hewitt E. and Stromberg K., Real and Abstract Analysis, Springer, 1975.
17. Royden H. L., Real Analysis, Mac Millan CollDiv, 1988, 2nd edition.