UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

M.A./M.Sc. SEMESTER I

MACC-101: Topology

Credit: 4 **T:04**

Course Outcomes:
1. Define and illustrate the concept of topological spaces and continuous functions,
2. Illustrate the concept of limit point, dense sets, interior, exterior, boundary points.
3. Identify and understand bases, sub-bases and different type of spaces like Lindelof, Separable, and their properties.

Unit I
Countable and uncountable sets, Schroeder-Bernstein theorem, Cantor's Theorem, Cantor's Sets, Cantor's continuum hypothesis, Zorn Lemma, Well ordering principle.

Unit II
Topological spaces: Definitions and Examples, open base and open subbase for a topology, Lindelof theorem, limit points, closure, interior; Continuous functions, Homeomorphisms; relative topology, Metric Topology, Product Topology, Weak topology, The function algebras C(X,R) and C(X,C).

Unit III
Compact spaces, Heine Borel theorem, product of spaces, Tychonoff theorem, generalized Heine Borel theorem, locally compact spaces, compactness for metric spaces, Ascoli's theorem.

Unit IV
Separation Axioms: T1 and Hausdorff spaces, completely regular and normal spaces, Urysohn's lemma; Tietze extension theorem. Uryohn's imbedding theorem; Stone Cech compactification.

Unit V
Connected spaces, the components of a space, totally disconnected space, locally connected space.

References
Text Books:

1. G.F. Simmons: Introduction to Topology and Modern Analysis, Mc-Graw Hill Int. BookCompany
2. J.R.Munkres: Topology - A first course, Prentice hall India Pvt. Ltd.

Suggested Readings:

1. J.L. Kelley: General Topology. Van Nostrand. Reinhold Co, New York 1995

Web References:
Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org
https://openlearninglibrary.mit/edu/courses
http://heecontent.upsdc.gov.in/SearchContent.aspx
https://www.lkouniv.ac.in/en/article/e-content-faculty-of-science

UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

MACC-102: Module Theory

Credit: 4 **T:04**

Course Outcomes:
1. Identify cyclic modules, simple modules, finitely generated modules etc.
2. Find a basis of a free module.
3. Use the basis to describe module homomorphisms.
4. Describe the structure of a finitely generated module over a PID.

Unit I

Modules-Definition and examples, simple modules, submodules, Module Homomorphisms, Quotient modules, torsion free and torsion modules.

Unit II

Direct sum of modules, Exact sequences, Short exact sequence, split exact sequences. Five lemma.

Unit III

Free modules, modules over division rings are free modules, invariant rank property.

Unit IV

Free modules over PID's, Invariant factor theorem for submodules, Finitely generated modules over PID, Chain of invariant ideals, Fundamental structure theorem for finitely generated module over a PID

Unit V
Projective and injective modules, Divisible group.

References:
Text Books:

1. V.Sahai and V. Bist: Algebra, Fourth Edition, Narosa.
2. I.B.S. Passi and I.S. Luther: Algebra, Volume 3 Modules, Narosa

Suggested Readings:

1. S. Lang: Algebra, Addison Wesley.

Web References:

Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org
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http://heecontent.upsdc.gov.in/SearchContent.aspx
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UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

MACC-103: Differential Geometry of Manifolds

Credit: 4 **T:04**

Course Outcomes:

1. Elaborate the concept of differentiable manifolds and their examples.
2. Clarify the concepts of vector fields, tangent vectors & tangent spaces in a manifold.
3. Apply various concepts of differential calculus to the settings of abstract set called manifold.
4. Use Riemannian metric on a given manifold to find the various types of curvatures with emphasis on the surface/ types of manifold.
5. Bring out different connections on Riemannian manifold and its properties.
6. Calculate curvature tensor & tensors of respective connections.

Unit I

Definition and examples of differentiable manifolds, Tangent vectors, Tangent Spaces, Vector fields and their examples, Jacobian map.

Unit II

Immersions and submersions, Diffeomorphism and their examples, Curve in a manifold, Integral curves and their examples, Distributions, Hypersurface of R^n, Submanifolds.

Unit III

Standard connection on R^n, Covariant derivative, Sphere map, Weerigarten map, Gauss equation, the Gauss curvature equation and Coddazi-Mainardi equations.

Unit IV

Invariant viewpoint, Cartan view point, coordinate view point, Difference Tensor of two connections, Torsion and curvature tensors.

Unit V

Riemannian Manifolds, Length and distance in Riemannian manifolds, Riemanian connection and curvature, Curves in Riemannian manifolds, Submanifolds of Riemannian manifolds.

References:

Text Books:

1. N.J. Hicks: Notes on Differential Geometry, D. Van Nostrand, 1965.
2. U. C. De., A. A. Shaikh: Differential Geometry of Manifolds, Narosa Publishing House.

Suggested Readings:

1. Y. Matsushima: Differentiable Manifolds, Marcel Dekker, INC. New York, 1972.

Web References:

Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org
https://openlearninglibrary.mit/edu/courses
http://heecontent.upsdc.gov.in/SearchContent.aspx
https://www.lkouniv.ac.in/en/article/e-content-faculty-of-science

MACC-104: Complex Analysis

Credit: 4 **T:04**

Course Outcomes:
1. Understand the topics of Complex Analysis needed to pursue research in pure mathematics.
2. Understand the properties of maximum modulus of a Complex valued function and the results based on that property.
3. Develop manipulation skills in the use of Rouche's theorem and Argument Principle.
4. Show knowledge of Gamma and Zeta functions with their properties and relationships.
5. Understand the Harmonic functions defined on a disc and concerned results.
6. Make factorization of entire functions having infinite number of zeros.

Unit I

Maximum Modulus Theorem, Schwarz's Lemma, Minimum Modulus Theorem, Hadamard's three circle theorem, automorphism of the unit disk. Convergence of sequences and series of complex numbers, absolute convergence.

Unit II

Uniform convergence of sequence and series of functions, Cauchy's criterion, Weierstrass's M-test, analytic convergence theorem. Absolute and uniform convergence of power series, integration and differentiation of power series, radius of convergence.

Unit III

Zeroes of holomorphic functions, Open Mapping Theorem, Inverse Function Theorem. Index of a closed path, meromorphic functions, argument principle, Rouche's theorem, residue at the point at infinity, indentation around a branch point and the branch cut, summation of series.

Unit IV

Function spaces: Hurwitz theorem, Infinite products, Weierstrass factorization theorem, Mittag-Leffler's theorem, Gamma functions and its properties, Riemann's Zeta function.

Unit V

Uniqueness of direct analytic continuation, Power series method of analytic continuation, Natural boundary, Schwarz's reflection principle, Harmonic Functions, Mean value property for harmonic functions, Harnack's inequality, Poisson formula, Jensen's formula, Poisson- Jensen's formula, Convex functions, Hadamard's three circle theorem as a convexity theorem, Canonical products, Hadamard's factorization theorem, order of entire functions.

References:

Text Books:

1. J. V. Deshpande: Complex Analysis, Tata McGraw-Hill Publishing Company Limited, New Delhi
2. E. C. Titchmarsh: Theory of functions, Oxford University Press
3. John B. Conway: Functions of one complex variables, Springer International

Suggested Readings:

1. R.V. Churchill, J.W. Brown, Complex Variables and Applications, McGraw Hill.

Web References:

Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org
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UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

Paper MACC-105: Fluid Mechanics

Credit: 4 **T:04**

Course Outcomes:
1. Understand the concept of fluid and their classification, models and approaches to study the fluid flow.
2. Formulate mass and momentum conservation principle and obtain solution for non viscous flow.
3. Know potential theorems, minimum energy theorem and circulation theorem.
4. Understand two dimensional motion, circle theorem and Blasius theorem.

Unit I
Types of fluids, Continuum hypothesis, Lagrangian and Eulerian method of describing fluid motion, Motion of Fluid element: Translation, Rotation and Deformation. Stream lines, Path lines and streak lines. Material derivative. Acceleration of a fluid particle in Cartesian, Cylindrical Polar and Spherical Polar Coordinates. Vorticity Vector, Vortex Lines, Rotational and Irrotational motion of fluid, Rotational velocity, Velocity Potential, Boundary surface, Boundary condition.

Unit II
Reynold transport theorem. Principle of conservation of Mass-Equation of continuity (By Lagrangian and Eulerian method. Equation of Continuity in different coordinate systems. Body force and Surface force. Euler's equation of motion-conservation of momentum, Bernoulli's Equation, Energy Equation, Impulsive effects.

Unit III
Irrotational motion in two dimensions: Stream function, Physical significance of stream function, Sinks, Doublets and their images in two dimension. Complex Velocity Potential. Sources, Milne-Thompson circle theorem.

Unit IV
Vortex, Vortex motion, Image of Vortex, Kelvin Circulation Theorem, Complex potential due to Vortex, Kirchhoff vortex Theorem, Blasius Theorem and Kutta-Joukowski Theorem.

Unit V
Irrotational motion produced by motion of circular cylinders in an infinite mass of liquid, Liquid Streaming past circular cylinder, Kinetic energy of liquid, Motion of sphere through a liquid at rest at infinity. Liquid streaming past a fixed sphere, Axis-Symmetric flow, Stoke's function.

References:
Text Books:

1. Frank Chorlton: Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi.
2. Z.U.A. Warsi: Fluid Dynamics, Theoretical and Computational Approaches, C.R.C. Press
3. S.W. Yuan: Foundation of Fluid Mechanics, Prentice Hall of India Pvt. Ltd. New Delhi
4. N. Curle and H J Davies: Modern fluid dynamics

Suggested Readings:

1. G. K. Bachelor: An Introduction to Fluid Dynamics. Cambridge University Press. London.
2. R.W. Fox, P.J. Pritchard and A.T. McDonald: Introduction to Fluid Mechanics, Seventh Edition, John Wiley & Sons, 2009.

Web References:
Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org
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UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

MAVC-101: Measure Theory & Integration

Credit: 4 **T:04**

Course Outcomes:

1. Display understanding of the essential foundations of important aspect of mathematical analysis.
2. Explain the measurability of a set of real numbers and measurable functions.
3. Differentiate between the Riemann integral and the Lebesgue integral.
4. Apply the Measure theory and theory of the integral in other branches of pure and applied mathematics.

Unit I

Algebra of sets, countable sets, Cantor set, Borel sets, outer measure of a set and its properties. Measurable sets.

Unit II

Lebesgue measure, a non-measurable set. Measurable functions and their properties. Concept of almost everywhere. Littlewood's three principles.

Unit III

The Lebesgue integration of bounded function over a set of finite measure, the Lebesgue, Bounded convergence theorem, the integral of a non-negative function, Fatou's Lemma, Monotone convergence theorem, the general Lebesgue integral, Lebesgue convergence theorem.

Unit IV

Differentiation of monotone functions, Vitali's Lemma, the four derivatives, the differentiation theorem. Functions of bounded variation, Differentiation of an integral, Absolute continuity.

Unit V

Inequalities and the Lp Spaces: The Lp Spaces, convex functions, Jensen's inequality, the inequalities of Holder and Minkowski, completeness of Lp(μ). Convergence in Measure, almost uniform convergence.

References:

Text Books:

1. H.L. Royden: Real Analysis, Pearson Prentice Hall
2. G.de Barra: Measure Theory and Integration, Wiley Eastern Ltd.

Suggested Readings:

1. Taylor, Measure Theory and Integration, American Mathematical Soc., 2006

Web References:

Digital platforms web links: NPTEL/SWAYAM/ MOOCS/Openstax.org
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UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

M.A./M.Sc. SEMESTER II

MACC-201: Advanced Topology

Credit: 4 **T:04**

Course Outcomes:
1. To understand countability axioms.
2. Knowledge of nets and filters.
3. Form new topological spaces by using product topology and study their compactness, connectedness etc.
4. Provide different examples of homotopy and fundamental groups.

Unit I
First Countability Axiom, Second Countability Axiom, Separable spaces, Countability and separable spaces, Countability and Lindeloff spaces, relations among them.

Unit II
Directed sets and nets, Topology and convergence of nets, Hausdorffness and nets, compactness and nets, Sub nets and Cluster points, Filters and their convergence, Base Filter, neighborhood filter and cofinite filter, Ultra filter

Unit III
Product Spaces :- Definition , Projection Mapping and related theorems, Product Spaces and compactness, Product Spaces and connectedness, Product spaces and separation axioms

Unit IV
Embedding in cubes, Definitions of evaluation mapping, Distinguishes points, Distinguishes points and closed sets, Embedding Lemma, Embedding Theorem, Urysohn’s Metrization Theorem

Unit V
Homotopy of Paths, Equivalence relation, Path homotopy Classes , Convex Sets, Contractible Sets, Fundamental Groups, Simply Connected Space, Path Connected Space, Homomorphism Induced by Mapping

References
Text Books:

1. G.F. Simmons: Introduction to Topology and Modern Analysis, Mc-Graw Hill Int. Book Company
2. J.R.Munkres: Topology- A First Course, Prentice Hall India India Pvt. Ltd.
   Suggested Readings:
3. J.L.Kelley: General Topology: Van Nostrand Reinhold Co., New York 1995

Web References:

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https://www.lkouniv.ac.in/en/article/e-content-faculty-of-science

MACC-202: Lie Algebra

Credit: 4 **T:04**

Course Outcomes:

1. To understand the concept of Lie algebras and derivations and classification of Lie algebras of dimension upto 3.
2. To understand connection between representations and modules.
3. To understand the structure of solvable and nilpotent Lie algebra.
4. Knowledge of Construction of universal enveloping of algebra of a Lie algebra.

Unit I

Basic Concepts – definition and construction of Lie and associative algebras, algebras of linear transformations, derivations, inner derivations of associative and lie algebras, determinations of Lie algebras of low dimensionalities.

Unit II

Representations and modules, some basic module operations, Ideals, solvability, nilpotency, extension of the base field.

Unit III

Weakly closed subsets of an associative algebra, nil weakly closed sets, Engel's theorem, Primary components, weight spaces.

Unit IV

Lie algebras with semi simple enveloping associative algebras, Lie's theorems, Applications to abstract Lie algebras, some counter examples.

Unit V

Universal enveloping algebras- definition and basic properties, The Poincare Birkhoff Witt theorem (without proof).

Books Recommended :

1. Lie Algebras – N. Jacobson, John Wiley

UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

MACC-203: Riemannian Manifolds and Bundle Theory

Credit: 4 **T:04**

Course Outcomes:
1. Use Riemannian metric for studying various types of curvatures in a manifold and to calculate Ricci tensor & Ricci curvature.
2. Recognize whether a given manifold is Einstein or not.
3. Explain Levi civita connection, koszulconnection and other important connections which are used in manifolds.
4. Understand the concept of tensors and forms .
5. Understand covariant derivative and contraction in manifold.
6. Understand Lie groups and Lie algebra with examples.
7. Explain the idea of principal fibre bundle linear fibre bundle and relation between them.

Unit I

Sectional Curvature, Schur’s Theorem, Riemannian Manifold , Geodesic in a Riemannian Manifold, Projective Curvature tensor, Concircular Curvature Tensor, Conformal curvature tensor, Conharmonic curvature tensor, Einstein Manifolds.

Unit II

Levi-Civita connection, Linear connection, Semi-symmetric connection, Quarter symmetric connection, Koszul connection, Ricci identity.

Unit III

Tensor and forms, Exterior derivative, contraction, Lie derivative, general covariant derivative.

Unit IV

Lie groups and Lie algebras with examples, homomorphism, isomorphism, one parameter subgroups and exponential map, The Lie transformations group.

Unit V

Principal fibre bundle, Linear frame bundle, Associated bundles, tangent bundle.

Books Recommended:

1. N.J. Hicks: Notes on Differential Geometry, D. Van Nostrand, 1965.
2. B.B. Sinha: An introduction to Modern Geometry.
3. U. C. De., A. A. Shaikh: Differential Geometry of Manifolds, Narosa Publishing House.

UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
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MACC-204: Special Functions

Credit: 4 **T:04**

Course Outcomes:
1. Perform operation on Gamma functions and their asymptotic expansion.
2. To understand the concept of Hypergeometric functions and their behavior.
3. To understand the concept of Bessel's functions and their asymptotic expansions..
4. Understand how the special function is solved by complex integrals.

Unit I
The Gamma Functions: Analytic Character, Tannery's theorem, Euler's limit formula, Canonical product, Asymptotic expansions, Watson's Lemma, Range of validity of the asymptotic expansion of $\Gamma(Z)$, Asymptotic behavior of $|\Gamma\ (x+iy)|$, Hankel's contour integral of $1/\Gamma(z)$.

Unit II
Bessel Functions $J_v(z)$: Differential equation and its solutions, Recurrence formulae for $J_v(z)$, Schlafli's contour integral for $J_v(z)$, Solution of Bessel's equation by Complex integrals, Hankel functions, Connection between the Bessel and Hankel functions, Asymptotic expansion of the Bessel's functions.

Unit III
The Hypergeometric Functions: Differential equation & its solution, Convergence of the series solution near a regular singularity, Solutions valid for large value of $|z|$, Solution when the exponent difference is an integer or zero, Second-order differential equation with three regular singularity.

Unit IV
Derivative of F(a,b;c,z), Integral representation of F(a,b;c,z), value of F(a,b;c,1) when Re(c-a-b)>0, Analytical continuation of F(a,b;c,z), Barnes's contour integral for F(a,b;c,z), The behaviour of F(a,b;c,z) near the point at infinity.

Unit V
Contiguous hypergeometric functions, Generalized hypergeometric equation, Generalized Hypergeometric functions, Confluent hypergeometric function, Asymptotic expansion, Asymptotic expansion of ${}_1F_1(a,b;\ z)$

Books recommended:
1. Theory of function of Complex Variable: E.T. Copson

UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

MACC-205: Advanced Fluid Mechanics

Credit: 4 **T:04**

Course Outcomes:

1. Understand the concept of fluid and their classification, models and approaches to study the fluid flow
2. Formulate mass and momentum conservation principle and obtain solution for non- viscous flow.
3. Understand two dimensional motion, circle theorem and Blasius theorem
4. Understand the concept of stress and strain in viscous flow and to derive Navier Stokes equation of motion and solve some exactly solvable problems

Unit I

Newton's law of viscosity, Nature of stress, Stress component in real fluid, Symmetry of stress tensor. Transformation of stress components. Stress invariants, Principal Stresses, Nature of Strain, Rates of strain components, transformation of rate of strain components, Rate of Strain Quadric, Relation between Stress and rate of Strain, Boundary conditions for viscous fluid.

Unit II

Navier-Stokes equation of motion-Conversation of momentum. Navier-Stokes equations in orthogonal coordinate systems (particularly in Cartesian, cylindrical and spherical coordinate systems), Energy Equation-Conversation of Energy. Energy dissipation function. Energy dissipation due to viscosity. Diffusion of vorticity.

Unit III

Plane Poiseuille and Couette flows between two parallel plates, Steady viscous flow through tubes of uniform cross-section in form of circle, ellipse and equilateral triangle under constant pressure gradient. Flow between two co-axial cylinders and concentric spheres, unsteady viscous flow over a flat plate.

Unit IV

Dynamical similarity, Reynolds number, slow viscous flow, Stoke's flow. Solution of Stokes equations, uniform flow past a sphere at low Reynolds number, torque and drag on a sphere due to a uniform flow. Flow past a circular cylinder, Stokes paradox.

Unit V:

Prandtl's Boundary layer concept, Boundary layer thickness-displacement, momentum of energy. Momentum and energy integrals, condition for separation, boundary layer flow along a semi-infinite plate in a uniform stream, Blasius solution.

Books Recommended:

1. G. K. Batchelor: An Introduction to Fluid Dynamics
2. Frank Chorlton: Text Book of Fluid Dynamics, C.B.S. Publishers, New Delhi.
3. Z.U.A. Warsi: Fluid Dynamics, Theoretical and Computational approaches, C.R.C. Press
4. S.W. Yuan: Foundation of Fluid Mechanics, Prentice Hall of India Pvt. Ltd., New Delhi
5. L. Rosenhead: Laminar Boundary layer, Oxford Press
6. R.W. Fox, P.J. Pritchard and A.T. McDonald: Introduction to Fluid Mechanics, Seventh Edition, John Wiley & Sons, 2009
7. Happel, J. and Brenner, H.: Low Reynolds Number Hydrodynamics with Special Applications to Particulate Media, Prentice-Hall, Inc., Englewood Clis, N.J., 1965

UNIVERSITY OF LUCKNOW
DEPARTMENT OF MATHEMATICS AND ASTRONOMY
SYLLABUS OF M.A./M.Sc. (MATHEMATICS)
(SESSION 2024-25 ONWARDS)

MACC-206: Advanced Integral & Partial Differential Equations

Credit: 4 **T:04**

Course Outcomes:

1. Understand the Integro-differential equation, Volterra Integro-differential equation, Fredholm Integro-differential equation.
2. Understand the properties of Classical Fredholms Theory.
3. Describe the different types of Singular integral equations, Abel integral equation, Cauchy principal value of Integrals.
4. Explain Hilbert kernel, Hilbert formula and solution of Hilbert-type. Singular integral equations.
5. Have good knowledge in integral and partial differential equation.

Unit I

Integro-differential equation, Volterra Integro-differential equation, Fredholm Integro-differential equation, The decomposition method for solving Volterra and Fredholm integro-differential equation. Conversion of initial and boundary value problems into integral equations. Volterra integral equation and their numerical solutions.

Unit II

Classical Fredholms Theory, The method of solution of Fredholm Equation, Fredholm First Theorem, Fredholm Second Theorem, Fredholm Third Theorem, Dirac-Delta Function and their properties.

Unit III

Singular integral equation, Abel integral equation, General forms of Abel Singular integral equation, Weakly singular kernel Cauchy principal value of integrals.

Unit IV

Hilbert kernel, Hilbert formula, Solution of Hilbert type singular integral equation of first and second kind. Symmetric Kernels, Fundamental properties of Eigen values and Eigen functions for symmetric kernels.

Unit V

Cauchy's method of characteristic, Cauchy's problem for Homogenous wave equation, Properties of Harmonic function, Energy equation, Methods of separation of variable for solving Laplace, wave and diffusion equations.

Books Recommended:

1. P. Kanwal, Birkhäuser: Linear Integral Equations (2nd ed.), RInc., Boston.
2. T. Amarnath: An Elementary Course in Partial Differential Equations, Narosa Publishing House, New Delhi, 2005.
3. I. N. Sneddon: Elements of Partial Differential Equations, Mc -Graw Hill, 1988.
4. Tyn Myint-U: Partial Differential Equations of Mathematical Physics, Elsevier Publications.
5. M Rahman, Integral Equations and their applications, WITT Press, Canada.

UNIVERSITY OF LUCKNOW
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MAVNC-201: Research Methodology

Credit: 00 **T:04**

Course Outcomes:
1. Identify and discuss the role and importance of research.
2. Identify and discuss the issues and concepts salient to the research process.
3. Identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design and implementing a research project.
4. Identify and discuss the concepts and procedures of sampling, data collection, analysis and reporting.
5. Read, comprehend and explain research article and writing a research article.

Unit I- Research Formulation and Design

Motivation and objectives- Research methods vs. Methodology, Steps of Research, Types of research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research, Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web.

Unit II- Data Measurement and Data Analysis

Measurement: Concept of measurement, Problems in measurements in research- Validity and Reliability. Levels of measurements- Nominal, Ordinal, Interval, Ratio. Observation and collection of data, methods of data collection, sampling methods, data processing and analysis and strategies and tools, data analysis, hypothesis testing.

Unit III- Soft Computing I

Computer and its role in research, some mathematical software like MATLAB,R etc and their application in research.

Unit IV- Soft Computing II

Software for paper formatting and paper presentation like Latex, MS Office etc.

Unit V- Research Ethics and Report Writing

Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Ethical issues related to publishing, Plagiarism, Software for detection of Plagiarism, publishing a research article.

Books Recommended:

1. Kothari, C.R., 1990, Research Methodology: Methods and Techniques. New Age International.
2. A Manual for writers of Research Papers, These, by Kate L. Turabian, Wayne C Booth, Gregory G. Colomb.
3. Garg, B.L.,Karadia, R,Agarwal,F.And Agarwal,U.K.,2002. An introduction by Research Methodology, RBSA Publishers.