Master of Science (Mathematics)
SECOND YEAR
Third Semester
Functional Analysis
Paper Code 21MAT23C1

Time: 03 Hours
Max Marks : 80

Course Outcomes
Students would be able to:
CO1 Be familiar with the completeness in normed linear spaces.
CO2 Understand the concepts of bounded linear transformation, equivalent formulation of continuity and spaces of bounded linear transformations.
CO3 Describe the solvability of linear equations in Banach Spaces, weak and strong convergence and their equivalence in finite dimensional space.
CO4 Learn the properties of compact operators.
CO5 Understand uniform boundedness principle and its consequences.

Section - I
Normed linear spaces, Metric on normed linear spaces, Completion of a normed space, Banach spaces, subspace of a Banach space, Holder and Minkowski inequality, Completeness of quotient spaces of normed linear spaces. Completeness of lp, Lp, Rn, Cn and C[a,b]. Incomplete normed spaces.

Section - II
Finite dimensional normed linear spaces and Subspaces, Bounded linear transformation, Equivalent formulation of continuity, Spaces of bounded linear transformations, Continuous linear functional, Conjugate spaces. Hahn-Banach extension theorem (Real and Complex form).

Section - III
Riesz Representation theorem for bounded linear functionals on Lp and C[a,b]. Second conjugate spaces, Reflexive space, Uniform boundedness principle and its consequences, Open mapping theorem and its application,Projections, Closed Graph theorem.

Section - IV
Equivalent norms, Weak and Strong convergence, Their equivalence in finite dimensional spaces. Weak sequential compactness, Solvability of linear equations in Banach spaces. Compact operator and its relation with continuous operator, Compactness of linear transformation on a finite dimensional space, Properties of compact operators, Compactness of the limit of the sequence of compact operators.

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

Books Recommended:

1. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.
2. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley.

3. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
4. A. H. Siddiqi, Khalil Ahmad and P. Manchanda, Introduction to Functional Analysis with Applications, Anamaya Publishers, New Delhi-2006.
5. K.C. Rao, Functional Analysis, Narosa Publishing House, Second edition.

Third Semester
Elementary Topology
Paper Code 21MAT23C2

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Get familiar with the concepts of topological space and continuous functions.

CO2 Generate new topologies from a given set with bases.

CO3 Describe the concept of homeomorphism and topological invariants.

CO4 Establish connectedness and compactness of topological spaces and proofs of related theorems.

CO5 Have in-depth knowledge of separation axioms and their properties.

Section - I

Definition and examples of topological spaces, Comparison of topologies on a set, Intersection and union of topologies on a set, Neighbourhoods, Interior point and interior of a set , Closed set as a complement of an open set , Adherent point and limit point of a set, Closure of a set, Derived set, Properties of Closure operator, Boundary of a set , Dense subsets, Interior, Exterior and boundary operators, Alternative methods of defining a topology in terms of neighbourhood system and Kuratowski closure operator.

Section - II

Relative(Induced) topology, Base and subbase for a topology, Base for Neighbourhood system. Continuous functions, Open and closed functions , Homeomorphism. Connectedness and its characterization, Connected subsets and their properties, Continuity and connectedness, Components, Locally connected spaces.

Section - III

Compact spaces and subsets, Compactness in terms of finite intersection property, Continuity and compact sets, Basic properties of compactness, Closeness of compact subset and a continuous map from a compact space into a Hausdorff and its consequence. Sequentially and countably compact sets, Local compactness and one point compatification.

Section - IV

First countable, Second countable and separable spaces, Hereditary and topological property, Countability of a collection of disjoint open sets in separable and second countable spaces, Lindelof theorem. T0, T1, T2 (Hausdorff) separation axioms, their characterization and basic properties.

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

Books Recommended :

C.W.Patty, Foundation of Topology, Jones & Bertlett, 2009.

Fred H. Croom, Principles of Topology, Cengage Learning, 2009.

George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.

J. L. Kelly, General Topology, Springer Verlag, New York, 2000.

J. R. Munkres, Toplogy, Pearson Education Asia, 2002.

K. Chandrasekhara Rao, Topology, Narosa Publishing House Delhi,2009.

K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd, 2006.

Third Semester
Fluid Dynamics
Paper Code 21MAT23C3

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Be familiar with continuum model of fluid flow and classify fluid/flows based on physical properties of a fluid/flow along with Eulerian and Lagrangian descriptions of fluid motion.

CO2 Derive and solve equation of continuity, equations of motion, vorticityequation, equation of moving boundary surface, pressure equation and equation of impulsive action for a moving inviscid fluid.

CO3 Calculate velocity fields and forces on bodies for simple steady and unsteady f low including those derived from potentials.

CO4 Understand the concepts of velocity potential, stream function and complex potential, and their use in solving two-dimensional flow problems applying complex-variable techniques.

CO5 Represent mathematically the potentials of source, sink and doublets in two-dimensions as well as three-dimensions, and study their images in impermeable surfaces.

Section - I

Kinematics - Velocity at a point of a fluid. Eulerian and Lagrangian methods. Stream lines, path lines and streak lines. Velocity potential. Irrotational and rotational motions. Vorticity and circulation. Equation of continuity. Boundary surfaces. Acceleration at a point of a fluid. Components of acceleration in cylindrical and spherical polar co-ordiantes.

Section - II

Pressure at a point of a moving fluid. Euler equation of motion. Equations of motion in cylindrical and spherical polar co-ordinates.

Bernoulli equation. Impulsive motion. Kelvin circulation theorem. Vorticity equation. Energy equation for incompressible flow. Kinetic energy of irrotational flow. Kelvin minimum energy theorem. Kinetic energy of infinite fluid. Uniqueness theorems.

Section - III

Axially symmetric flows. Liquid streaming part a fixed sphere. Motion of a sphere through a liquid at rest at infinity. Equation of motion of a sphere. Kinetic energy generated by impulsive motion. Motion of two concentric spheres.

Three-dimensional sources, sinks and doublets. Images of sources, sinks and doublets in rigid impermeable infinite plane and in impermeable spherical surface.

Section - IV

Two dimensional motion; Use of cylindrical polar co-ordinates. Stream function. Axisymmetric flow. Stoke stream function. Stoke stream function of basic flows. Irrotational motion in two-dimensions. Complex velocity potential. Milne-Thomson circle theorem. Two-dimensional sources, sinks, doublets and their images. Blasius theorem.

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

Books Recommended:

W.H. Besaint and A.S. Ramasey, A Treatise on Hydromechanics, Part II, CBS Publishers, Delhi, 1988.
F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985
O'Neill, M.E. and Chorlton, F., Ideal and Incompressible Fluid Dynamics, Ellis Horwood Limited, 1986.
R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
G.K. Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi, 1994.

Third Semester
Discrete Mathematics
Paper Code 21MAT23DA1

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Be familiar with fundamental mathematical concepts and terminology of discrete mathematics and discrete structures.

CO2 Express a logic sentence in terms of predicates, quantifiers and logical connectives.

CO3 Use finite-state machines to model computer operations.

CO4 Apply the rules of inference and contradiction for proofs of various results.

CO5 Evaluate boolean functions and simplify expressions using the properties of boolean algebra.

Section - I

Recurrence Relations and Generating Functions, Some number sequences, Linear homogeneous recurrence relations, Non-homogeneous recurrence relations, Generating functions, Recurrences and generating functions, Exponential generating functions.

Section - II

Statements Symbolic Representation and Tautologies, Quantifiers, Predicates and validity, Prepositional Logic.

Lattices as partially ordered sets, their properties, Lattices as Algebraic systems. Sub lattices, Direct products and Homomorphism, Some special lattices e.g. complete, Complemented and Distributive Lattices.

Section - III

Boolean Algebras as Lattices, Various Boolean Identities, The switching Algebra.Example, Subalgebras, Direct Products and Homomorphism, Joint-irreducible elements,Atoms and Minterms, Boolean forms and their equivalence, Minterm Boolean forms,

Sum of Products, Cononical forms, Minimization of Boolean functions, Applications ofBoolean Algebra to Switching Theory (using AND, OR and NOT gates.) The Karnaugh method.

Section - IV

Finite state Machines and their Transition table diagrams, Equivalence of Finite State, Machines, Reduced Machines, Homomorphism. Finite automata, Acceptors, Non-deterministic, Finite Automata and equivalence of its power to that of deterministic Finite automata, Moore and Mealy Machines.

Grammars and Language: Phrase-Structure Grammars, Requiting rules, Derivation, Sentential forms, Language generated by a Grammar, Regular, Context -Free and context sensitive grammars and Languages, Regular sets, Regular Expressions and the pumping Lemma.

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

Books Recommended:

Kenneth H. Rosen, Discrete Mathematics and Its Applications, Tata McGraw-Hill, Fourth Edition.

Seymour Lipschutz and Marc Lipson, Theory and Problems of Discrete Mathematics, Schaum Outline Series, McGraw-Hill Book Co, New York.

John A. Dossey, Otto, Spence and Vanden K. Eynden, Discrete Mathematics, Pearson, Fifth Edition.

J.P. Tremblay, R. Manohar, “Discrete mathematical structures with applications to computer science”, Tata-McGraw Hill Education Pvt.Ltd.
J.E. Hopcraft and J.D.Ullman, Introduction to Automata Theory, Langauages and Computation, Narosa Publishing House.
M. K. Das, Discrete Mathematical Structures for Computer Scientists and Engineers, Narosa Publishing House.
C. L. Liu and D.P.Mohapatra, Elements of Discrete Mathematics- A Computer Oriented Approach, Tata McGraw-Hill, Fourth Edition.

Third Semester

Analytical Number Theory

Paper Code : 21MAT23DB1

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Know about the classical results related to prime numbers and get familiar with the irrationality of *e* and *Π*.

CO2 Study the algebraic properties of Un and Qn.

CO3 Learn about the Waring problems and their applicability.

CO4 Learn the definition, examples and simple properties of arithmetic functions and about perfect numbers.

CO5 Understand the representation of numbers by two or four squares.

Section - I

Distribution of primes, Fermat and Mersenne numbers, Farey series and some results concerning Farey series, Approximation of irrational numbers by rationals, Hurwitz theorem, Irrationality of e and □.

Section - II

The arithmetic in Zn, The group Un, Primitive roots and their existence, the group Upn (p-odd) and U2n, The group of quadratic residues Qn , Quadratic residues for prime power moduli and arbitrary moduli, The algebraic structure of Un and Qn .

Section -III

Riemann Zeta Function □(s) and its convergence, Application to prime numbers,□(s) as Euler product, Evaluation of □(2) and □(2k). Diophantine equations ax + by = c, x2+y2 = z2 and x4+y4 = z4, The representation of number by two or four squares, Waring problem, Four square theorem, The numbers g(k) & G(k), Lower bounds for g(k) & G(k).

Section - IV

Arithmetic functions □(n), □(n), □(n) and □k(n), U(n), N(n), I(n), Definitions and examples and simple properties, Perfect numbers, Mobius inversion formula, The Mobius function □n, The order and average order of the function □(n), □(n) and □(n).

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

Books Recommended:

1. G.H. Hardy and E.M. Wright, An Introduction to the Theory of Numbers.
2. D.M. Burton, Elementary Number Theory.
3. N.H. McCoy, The Theory of Number by McMillan.
4. I. Niven, I. and H.S. Zuckermann, An Introduction to the Theory of Numbers.
5. A. Gareth Jones and J Mary Jones, Elementary Number Theory, Springer Ed. 1998.

Third Semester
Disaster Management
Paper Code 21ENVO2

MM. Th 80+IA 20
Time : 3 Hours.

Note:
1. Seven questions will be set in all.
2. Question No. 1 will be objective covering the entire syllabus & compulsory. The remaining six questions will be set with two questions from each unit. The candidate will be required to attempt five in total, Question I and four by selecting at least one from each unit.

UNIT- I

Disaster- Causes and phases of disaster, Rapid onset and slow onset disasters. Nature and responses to geo-hazards, trends in climatology, meteorology and hydrology. Seismic activities. Changes in Coastal zone, coastal erosion, beach protection. Coastal erosion due to natural and manmade structures.

UNIT- II

Floods and Cyclones: causes of flooding, Hazards associated with flooding. Flood forecasting. Flood management, Integrated Flood Management and Information System (IFMIS), Flood control. Water related hazards- Structure and nature of tropical cyclone, Tsunamis – causes and physical characteristics, mitigation of risks.

UNIT- III

Earthquakes: Causes and characteristics of ground-motion, earthquake scales, magnitude and intensity, earthquake hazards and risks, Volcanic land forms, eruptions, early warning from satellites, risk mitigation and training, Landslides.

Mitigation efforts: UN draft resolution on Strengthening of Coordination of Humanitarian Emergency Assistance, International Decade for Natural Disaster Reduction (IDNDR), Policy for disaster reduction, problems of financing and insurance.

Reference Books:

1. Bolt, B.A. Earthquakes , W. H. Freeman and Company, New York. 1988
2. Carter, N,W. Disaster Management: A Disaster Manager's Hand Book, Asian Development Bank, Manila. 1992
3. Gautam Ashutosh. Earthquake: A Natural Disaster, Ashok Publishing House, New Delhi. 1994
4. Sahni, P.and Malagola M. (Eds.).Disaster Risk Reduction in South Asia, Prentice-Hall of India, New Delhi. 2003.
5. Sharma, V.K. (Ed.). Disaster Management, IIPA, New Delhi. 1995.
6. Singh T. Disaster management Approaches and Strategies, Akansha Publishing House, New Delhi. 2006
7. Sinha, D. K. Towards Basics of Natural Disaster Reduction, Research Book Centre, New Delhi. 2006
8. Smith, K. Environmental Health, Assessing Risk and Reduction Disaster, 3rd Edition, Routledge, London. 2001 21.

Fourth Semester
Inner Product Spaces and Measure Theory
Paper Code 21MAT24C1

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Understand Hilbert spaces and related terms.

CO2 Introduce the concept of projections, measure and outer measure.

CO3 Learn about Hahn, Jordan and Radon-Nikodyn decomposition theorem, Lebesgue-stieltjes integral, Baire sets and Baire measure.

Section - I

Hilbert Spaces: Inner product spaces, Hilbert spaces, Schwarz inequality, Hilbert space as normed linear space,Convex sets in Hilbert spaces, Projection theorem, Orthonormal sets, Separability, Total Orthonormal sets, Bessel inequality, Parseval identity.

Section - II

Conjugate of a Hilbert space, Riesz representation theorem in Hilbert spaces, Adjoint of an operator on a Hilbert space, Reflexivity of Hilbert space, Self-adjoint operators, Positive operators, Product of Positive Operators.

Section-III

Projection operators, Product of Projections, Sum and Difference of Projections, Normal and unitary operators, Projections on Hilbert space, Spectral theorem on finite dimensional space. Convex functions, Jensen inequalities, Measure space, Generalized Fatou lemma, Measure and outer measure, Extension of a measure, Caratheodory extension theorem.

Section - IV

Signed measure, Hahn decomposition theorem, Jordan decomposition theorem, Mutually signed measure, Radon – Nikodyn theorem,Lebesgue decomposition, Lebesgue - Stieltjes integral, Product measures, Fubini theorem, Baire sets, Baire measure, Continuous functions with compact support.

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

Books Recommended:

1. H.L. Royden, Real Analysis, MacMillan Publishing Co., Inc., New York, 4th Edition, 1993.
2. E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley (1978).
3. S.K. Berberian, Measure and Integration, Chelsea Publishing Company, New York, 1965.
4. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963
5. K.C. Rao, Functional Analysis, Narosa Publishing House, Second edition, 2006.

Fourth Semester

Classical Mechanics

Paper **21MAT24C2**

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Be familiar with the concepts of momental ellipsoid, equimomental systems and general motion of a rigid body.

CO2 Understand ideal constrains, general equation of dynamics and Lagrange's equations for potential forces.

CO3 Describe Hamiltonian function, Poincare-Carton integral invariant and principle of least action.

CO4 Get familiar with canonical transformations, conditions of canonicity of a transformation in terms of Lagrange and Poisson brackets.

Section –I

Moments and products of inertia, Angular momentum of a rigid body, Principal axes and principal moment of inertia of a rigid body, Kinetic energy of a rigid body rotating about a fixed point, Momental ellipsoid and equimomental systems, Coplanar mass distributions, General motion of a rigid body. (Relevant topics from the book of Chorlton).

Section –II

Free & constrained systems, Constraints and their classification, Holonomic and non-holonomic systems, Degree of freedom and generalised coordinates, Virtual displacement and virtual work, Statement of principle of virtual work (PVW), Possible velocity and possible acceleration, Ideal constraints**, G**eneral equation of dynamics for ideal constraints, Lagrange equations of the first kind. D' Alembert principle,

Independent coordinates and generalized forces, Lagrange equations of the second kind, Generalized velocities and accelerations. Uniqueness of solution, Variation of total energy for conservative fields. Lagrange variable and Lagrangian function L(t, Qi,), Lagrange equations for potential forces, Generalized momenta pi. I q□

Section -III

Hamiltonian variable and Hamiltonian function, Donkin theorem, Ignorable coordinates, Hamilton canonical equations, Routh variables and Routh function R, Routh equations, Poisson Brackets and their simple properties, Poisson identity, Jacobi – Poisson theorem.

Hamilton action and Hamilton principle, Poincare – Carton integral invariant, Whittaker equations, Jacobi equations, Lagrangian action and the principle of least action.

Section -IV

Canonical transformation, Necessary and sufficient condition for a canonical transformation, Univalent Canonical transformation, Free canonical transformation, Hamilton-Jacobi equation, Jacobi theorem, Method of separation of variables in HJ equation, Lagrange brackets, Necessary and sufficient conditions of canonical character of a transformation in terms of Lagrange brackets, Jacobian matrix of a canonical transformation, Conditions of canonicity of a transformation in terms of Poison brackets, Invariance of Poisson Brackets under canonical transformation.

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

Books Recommended:

F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
P.V. Panat, Classical Mechanics, Narosa Publishing House, New Delhi, 2005.
N.C. Rana and P.S. Joag, Classical Mechanics, Tata McGraw- Hill, New Delhi, 1991.
Louis N. Hand and Janet D. Finch, Analytical Mechanics, CUP, 1998.
K. Sankra Rao, Classical Mechanics, Prentice Hall of India, 2005.
M.R. Speigal, Theoretical Mechanics, Schaum Outline Series.
F. Chorlton, Textbook of Dynamics, CBS Publishers, New Delhi.

Fourth Semester

Viscous Fluid Dynamics

Paper Code 21MAT24C3

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Understand about vortex motion and its permanence, rectilinear vertices, vortex images and specific types of rows of vortices.

CO2 Model mathematically the compressible fluid flow and describe various aspects of gas flow.

CO3 Acquire knowledge of viscosity, relation between shear stress and rates of shear strain for Newtonian fluids, energy dissipation due to viscosity, and laminar and turbulent flows.

CO4 Derive the equations of motion for a viscous fluid flow and use them for study of flow Newtonian fluids in pipes and ducts for laminar flow fields, and their applications in mechanical engineering.

CO5 Get familiar with dimensional analysis and similitude, and understand the common dimensional numbers of fluid dynamics along with their physical and mathematical significance.

Section - I

Vorticity in two dimensions, Circular and rectilinear vortices, Vortex doublet, Images, Motion due to vortices, Single and double infinite rows of vortices. Karman vortex street.
Wave motion in a Gas. Speed of sound in a gas. Equation of motion of a Gas. Subsonic, sonic and supersonic flows. Isentropic gas flow, Flow through a nozzle.

Section - II

Stress components in a real fluid. Relation between Cartesian components of stress. Translational motion of fluid element. Rates of strain. Transformation of rates of strains. Relation between stresses and rates of strain. The co-efficient of viscosity and laminar flow. Newtonian and non-Newtonian fluids.
Navier-Stoke equations of motion. Equations of motion in cylindrical and spherical polar co-ordinates. Diffusion of vorticity. Energy dissipation due to viscosity.

Section - III

Plane Poiseuille and Couette flows between two parallel plates. Theory of lubrication. Hagen Poiseuille flow. Steady flow between co-axial circular cylinders and concentric rotating cylinders. Flow through tubes of uniform elliptic and equilateral triangular cross-section. Unsteady flow over a flat plate. Steady flow past a fixed sphere. Flow in convergent and divergent chennals.

Section - IV

Dynamical similarity. Inspection analysis. Non-dimensional numbers. Dimensional analysis. Buckingham □-theorem and its application. Physical importance of non-dimensional parameters. Prandtl boundary layer. Boundary layer equation in two-dimensions. The boundary layer on a flat plate (Blasius solution). Characteristic boundary layer parameters. Karman integral conditions. Karman-Pohlhausen method.

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

Books Recommended:
1. W.H. Besaint and A.S. Ramasey, A Treatise on Hydromechanics, Part II, CBS Publishers,Delhi, 1988.
2. F. Chorlton, Text Book of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985
3. O'Neill, M.E. and Chorlton, F., Ideal and Incompressible Fluid Dynamics, Ellis Horwood Limited, 1986.
4. O'Neill, M.E. and Chorlton, F. , Viscous and Compressible Fluid Dynamics, Ellis Horwood Limited, 1989.
5. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi, 1976.
6. H. Schlichting, Boundary-Layer Theory, McGraw Hill Book Company, New York, 1979.
7. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
8. G.K. Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi, 1994.

Fourth Semester
General Topology
Paper Code 21MAT24DA1

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Have the knowledge of the separation axioms.

CO2 Understand the concept of product topological spaces and their properties.

CO3 Be familiar with Tychonoff embedding theorem and Urysohn's metrization theorem.

CO4 Know about methods of generating nets and filters and their relations.

CO5 Describe paracompact spaces and their characterizations.

Section - I

Regular, Normal, T3 and T4 separation axioms, Their characterization and basic properties, Urysohn lemma and Tietze extension theorem, Regularity and normality of a compact Hausdorff space, Complete regularity, Complete normality, T321and T5 spaces, Their characterization and basic properties.

Section - II

Product topological spaces, Projection mappings, Tychonoff product topology in terms of standard subbases and its characterization, Seperation axioms and product spaces, Connectedness, Locally connectedness and compactness of product spaces, Product space as first axiom space, Tychon off product theorem.

Embedding and Metrization : Embedding lemma and Tychonoff embedding theorem, Metrizable spaces, Urysohn metrization theorem.

Section - III

Nets : Nets in topological spaces, Convergence of nets, Hausdorffness and nets, Subnet and cluster points, Compactness and nets, Filters : Definition and examples, Collection of all filters on a set as a poset, Methods of generating filters and finer filters, Ultra filter and its characterizations, Ultra filter principle, Image of filter under a function, Limit point and limit of a filter, Continuity in terms of convergence of filters, Hausdorffness and filters, Canonical way of converting nets to filters and vice versa, Stone-Cech compactification(Statement Only).

Section - IV

Covering of a space, Local finiteness, Paracompact spaces, Paracompactness as regular space, Michaell theorem on characterization of paracompactness, Paracompactness as normal space, A. H. Stone theorem, Nagata- Smirnov Metrization theorem.

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

Books Recommended:

George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963

K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd.

J. L. Kelly, General Topology, Springer Verlag, New York, 2000.

J. R. Munkres, Toplogy, Pearson Education Asia, 2002. W.J. Pervin, Foundations of General Topology, Academic Press Inc. New York, 1964.
K. Chandrasekhara Rao, Topology, Narosa Publishing House Delhi,2009.
Fred H. Croom, Principles of Topology, Cengage Learning, 2009.

Fourth Semester
Algebraic Number Theory
Paper Code 21MAT24DB1

Time: 03 Hours
Max Marks : 80

Course Outcomes

Students would be able to:

CO1 Learn the arithmetic of algebraic number fields.
CO2 Prove theorems for integral bases and unique factorization into ideals.
CO3 Factorize an algebraic integer into irreducibles.
CO4 Obtain the ideals of an algebraic number ring.
CO5 Understand ramified and unramified extensions and their related results.

Section -I

Algebraic Number and Integers : Gaussian integers and its properties, Primes and fundamental theorem in the ring of Gaussian integers, Integers and fundamental theorem in Q(ω) where ω3 = 1, Algebraic fields, Primitive polynomials, The general quadratic field Q(√m), Units of Q(√2), Fields in which fundamental theorem is false, Real and complex Euclidean fields, Fermat theorem in the ring of Gaussian integers, Primes of Q(√2) and Q(√5).

Section -II

Countability of set of algebraic numbers, Liouville theorem and generalizations, Transcendental numbers, Algebraic number fields, Liouville theorem of primitive elements, Ring of algebraic integers, Theorem of primitive elements.

Section -III

Norm and trace of an algebraic number, Non degeneracy of bilinear pairing, Existence of an integral basis, Discriminant of an algebraic number field, Ideals in the ring of algebraic integers, Explicit construction of integral basis, Sign of the discriminant, Cyclotomic fields, Calculation for quadratic and cubic cases.

Section -IV

Integral closure, Noetherian ring, Characterizing Dedekind domains, Fractional ideals and unique factorization, G.C.D. and L.C.M. of ideals, Chinese remainder theorem, Dedekind theorem, Ramified and unramified extensions, Different of an algebraic number field, Factorization in the ring of algebraic integers.

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

Books Recommended:

1. Esmonde and M Ram Murty, Problems in Algebraic Number Theory, GTM Vol. 190, Springer Verlag, 1999.
2. G.H. Hardy and E.M. Wright, An Introduction to the Theory of Numbers
3. W.J. Leveque, Topics in Number Theory – Vols. I, III Addition Wesley.
4. H. Pollard, The Theory of Algebraic Number, Carus Monogrpah No. 9, Mathematical Association of America.
5. P. Riebenboim, Algebraic Numbers – Wiley Inter-science.
6. E. Weiss, Algebraic Number Theory, McGraw Hill.