Semester-III

Course Code: MTH-501

Course Name: **Topology**

Instructor Name: Dr. S. K. Srivastava & Anuj Kumar

Credit Equivalent: 04 Credits (One credit is equivalent to 10 hours of lectures / organised classroom activity / contact hours; 5 hours of laboratory work / practical / field work / Tutorial / teacher-led activity and 15 hours of other workload such as independent individual / group work; obligatory / optional work placement; literature survey / library work; data collection / field work; writing of papers / projects / dissertation / thesis; seminars, etc.)

Attendance Requirement:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in the examination.

Evaluation Criteria:

1. Mid Term Examination: 25%
2. End Term Examination: 50%
3. Continuous Internal Assessment: 25%
    - i) Assignments 20%
    - ii) Class participation 5%

Course Contents:

Unit-I:

Topological Spaces, Bases for Topology, The Subspace Topology, Sub-basis for Topology, The Order Topology, The Product Topology, Closed Sets, Definition of Topology in terms of Closed Set, Limit Points, the Neighborhood System of a point, Subspace Topology, characterization of Closed Sets in a Subspace, Closure and Interior of a Set, characterization of Closure of a Set in a Subspace.

Unit-II:

Definition of a Continuous Function in a Topological Space, various characterizations of Continuous Function in a Topological Space, Quotient Spaces, Homeomorphisms, Definition of a Topological Property, the Product Topology, the Metric Topology, the Connected Spaces, Path Connectedness, Components and Local Connectedness

Unit-III:

Compact Spaces, the Image of a Compact Space under a Continuous Function, the Product of finitely many Compact Spaces, the Finite Intersection Property, Limit Point Compactness, Convergence in a Topological Space, Sequential Compactness, Local Compactness

Unit-IV:

First Countable Spaces, Second Countable Spaces, Lindelof’s Theorem, Separable Spaces, Product of First and Second Countable Spaces, the Separation Axioms: the Regular Spaces, the Normal Spaces, T1, T2, T3 and T4 spaces

Prescribed Text Book:

(i) Topology By J. R. Munkres. Second Edition, Prentice Hall
(ii) General Topology By Stephen Willard, Dover

Suggested Additional Reading:

(i) General Topology By J. L. Kelley. Graduate Texts in Mathematics, Springer
(ii) Basic Topology By M. A. Armstrong. Undergraduate Texts in Mathematics, Springer

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Course Code: IAM 506
Course Name: Finite Element Analysis
Credit: 04
Course Instructor: Dr. Rakesh Kumar

Credits Equivalent: 04 Credits (One credit is equivalent to 10 hours of lectures / organized classroom activity / contact hours; 5 hours of laboratory work / practical / field work / Tutorial / teacher-led activity and 15 hours of other workload such as independent individual/ group work; obligatory/ optional work placement; literature survey/ library work; data collection/ field work; writing of papers/ projects/dissertation/thesis; seminars, etc.)
Course Objective: The main purpose of this course is to acquaint the students with the analysis and applications of finite element methods.

Attendance Requirements:
Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must failing which a student may not be permitted to appear in examination.

Evaluation Criteria:
1. Mid Term Examination: 25%
2. End Term Examination: 50%
3. Counselling, Activities and Tutorials (CAT): 25%
i. Subjective / Objective Assignment: 10 %
ii. Numerical Assignments using programming: 10 %
iii. Presentations and Class Tests: 5 %

Course Contents:

Unit I: Basic concepts of function spaces, strong forms, variational or weak forms, minimization forms, equivalence between various forms, Lax-Milgram lemma, Galerkin orthogonality, priori error estimate, posteriori error estimate, stability theorem, discretization of weak and minimization forms in FEM.

Unit II: The energy norm, FEM for model problems; Laplace equation, Poisson equation, biharmonic problem, convection diffusion problem, heat conduction, essential and natural boundary conditions.

Unit III: Finite element space, types of elements (linear, quadratic, cubic) and shape functions, 1D elements, 2D elements (triangles, rectangles, quadrilaterals), 3D elements (tetrahedron, prisms, wedge, pyramidal), iso-parametric mapping.

Unit IV: Assembly of FEM equations and solutions, transport problem, plate problem, Stokes equation, eigenvalue and time dependent problems.

Prescribed Text Books:

1. C. Johnson (2009) Numerical solution of partial differential equations by finite element method. Dover publications, INC, New York.
2. M.G. Larson, F. Bengzon (2010). The finite element: Theory, implementation, and practice, Springer

Suggested Additional Readings:

1. S.C. Brenner, L.R. Scott (2008). The Mathematical Theory of Finite Element Methods, Springer.
2. J.N. Reddy (2006).An Introduction to Finite Element Method. McGraw Hill.
3. S.R. Singiresu (2005). The Finite Element Method in Engineering. Fourth Edition. Elsevier Inc.

Course Code: MTH 503

Course Name: Discrete Mathematics

Credits: 04

Name of Teacher: Guest Faculty

Credits Equivalent: 04 Credits (One credit is equivalent to 10 hours of lectures / organized classroom activity / contact hours; 5 hours of laboratory work / practical / field work / Tutorial / teacher-led activity and 15 hours of other workload such as independent individual/ group work; obligatory/ optional work placement; literature survey/ library work; data collection/ field work; writing of papers/ projects/dissertation/thesis; seminars, etc.)

Course Objective: To introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in algorithms and data structures. To show students how discrete mathematics can be used in modern computer science (with the focus on algorithmic applications) and understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

Attendance Requirements:
Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must failing which a student may not be permitted to appear in examination.

Evaluation Criteria:
1. Mid Term Examination: 25%
2. End Term Examination: 50%
3. Counselling, Activities and Tutorials (CAT): 25%
i. Subjective / Objective Assignment: 20 %
ii. Presentations and Class Tests: 5 %

Course Contents:

Unit I
Logic, Propositional Equivalences, Partial Ordered Sets, Lattices and Algebraic Systems, Principle of Duality, Basic Properties of Algebraic Systems defined by Lattices, Distributive and Complemented Lattices, Boolean Lattices and Boolean Algebras.

Unit II:
Boolean Functions and Boolean Expressions, Propositional Calculus, Pigeonhole principle: Simple form, Pigeonhole principle: Strong form, A theorem of Ramsey. Two basic counting principles, Permutations of sets, Combinations of Sets, Generating permutations, Inversions in permutations, Generating combinations,

Unit III:
Pascal's formula, The binomial theorem, Identities, Unimodality of binomial coefficients, The multinomial theorem, Newton's binomial theorem. The inclusion-exclusion principle, Combinations with repetition, Derangements. Some number sequences, linear homogeneous recurrence relations, Non-homogeneous recurrence relations.

Unit IV:
Graph Theory:- Basic properties, Eulerian trails, Hamilton chains and cycles, bipartite multigraphs, Trees, The Shannon switching game, Digraphs and Networks, Chromatic number, Plane and planar graphs, A 5-color theorem.

Prescribed Text Books:

1. CL. Liu and DP. Mohapatra, (2012) Elements of Discrete Mathematics. 4th Edition, Tata McGraw Hill Education.
2. Richard A. Brualdi, Introductory Combinatorics, third Edition, (Chapter 2, Chapter 3(3.1, 3.2, 3.3), Chapter 4(4.1, 4.2 ,4.3), Chapter 5(5.1 to 5.6), Chapter6(6.1, 6.2, 6.3), Chapter 7(7.1 to 7.4) and Chapter 11(11.1 to 11.6), Chapter 13(13.1 to 13.3).

Suggested Additional Readings:

1. J. Matousek and J. Nesetril (2005). Invitation to Discrete Mathematics. Oxford University Press.
2. G. Edgar and PM. Michael (2003). Discrete Mathematics with Graph Theory. Prentice Hall.
3. Kenneth H. Rosen, Discrete Mathematics and Its Application, Tata McGraw-Hill, Fourth Edition.

Course Code: MTH 504

Course Name: Mechanics

Credits: 04

Name of Teacher: Guest Faculty

Credits Equivalent: 04 Credits (One credit is equivalent to 10 hours of lectures / organized classroom activity / contact hours; 5 hours of laboratory work / practical / field work / Tutorial / teacher-led activity and 15 hours of other workload such as independent individual/ group work; obligatory/ optional work placement; literature survey/ library work; data collection/ field work; writing of papers/ projects/dissertation/thesis; seminars, etc.)

Course Objective: To develop familiarity with the physical concepts and facility with the mathematical methods of classical mechanics, and to develop skills in formulating and solving physics problems.

Attendance Requirements:
Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must failing which a student may not be permitted to appear in examination.

Evaluation Criteria:
1. Mid Term Examination: 25%
2. End Term Examination: 50%
3. Counselling, Activities and Tutorials (CAT): 25%
i. Subjective / Objective Assignment: 20 %
ii. Presentations and Class Tests: 5 %

Course Contents:

Unit I
Generalized coordinates, constraints, work and potential energy, generalized forces, the principle of virtual work, introduction to Lagrange's equation, Lagrange's equation for a particle in a plane, the classification of dynamical systems, Lagrange's equation for any simple dynamical system.

Unit II:
Lagrange's equation for non-holonomic systems with moving constraints, Lagrange's equations for impulsive motion, Hamilton's principle, stationary values of a function, constrained stationary values, stationary value of a definite integral, Hamilton's equation, Derivation of Hamilton's equations.

Unit III:
Ignorable coordinates, the Routhian function, the form of Hamiltonian function, modified Hamilton's principle, principle of least action, the Hamilton-Jacobi equation.

Unit IV:
Lagrange and Poission brackets, calculus of variation, the Brachistochrone problem, invariance of Lagrange and Poission brackets under canonical transformations.

Prescribed Text Books:

1. John L. Synge and Byron A. Griffith Principles of Mechanics, McGraw Hill, 3rd Edition.
2. Donald T. Green and Wood, Classical Dynamics, Prentice Hall of India, 1979.
3. K Sankara Rao, Classical Mechanics, Prentice Hall of India, 2005.

Course Code:MTH-405

Course Name: Lebesgue Measure and Integration

Instructor Name: Dr S. K. Srivastava

Credit Equivalent: 04 Credits (One credit is equivalent to 10 hours of lectures / organised classroom activity / contact hours; 5 hours of laboratory work / practical / field work / Tutorial / teacher-led activity and 15 hours of other workload such as independent individual / group work; obligatory / optional work placement; literature survey / library work; data collection / field work; writing of papers / projects / dissertation / thesis; seminars, etc.)

Course Objective: The purpose of this course is to Course Objective: acquaint the students with the concept of measure, a means for comparing the size of sets and generalizing intuitive notions such as length and area, and moves on to describe the elements of the Lebesgue theory of integration. Lebesgue integration is a fundamental tool for advanced study in areas of mathematics such as functional analysis and potential theory, and provides the foundation for the axiomatic treatment of probability theory.

Attendance Requirement:

Students are expected to attend all lectures in order to be able to fully benefit from the course. A minimum of 75% attendance is a must, failing which a student may not be permitted to appear in examination.

Evaluation Criteria:

ii) Mid Term Examination: 25%

iii) End Term Examination: 50%

iv) Continuous Internal Assessment: 25%

4.	Assignment	15%
5.	Class participation	5%
6.	Class tests	5%

Course Contents:

Unit I: Set theory, Topological ideas, sequence and limits, functions and mapping, cardinal number and

Countability, properties of open sets and Cantor’s like sets.

Unit II: Lebesgue outer measure, measurable sets, properties of measurable sets, Borel set and their measurability, characterizations of measurable sets, measurable functions and their properties.

Unit III: Borel measurable functions, convergence in measure, Lebesgue Integrals and integral of non-negative measurable functions.

Unit IV: The four derivates, Continuous and Non- differentiable functions, functions of bounded variation, Lebesgue’s differentiation theorem, differentiation, integration and the Lebesgue set.

Prescribed Text Books:

1. P.K. Jain, V.P. Gupta and P. Jain (2012), Lebesgue measure and integration, Anshan Publishers, 2nd Edition.

Suggested Additional Readings:

1. P. R. Halmos, Measure Theory, Graduate Text in Mathematics, Springer-Verlag, 1979.
2. G. De Barra (2003), Measure theory and Integration, Horwood Publishing.
