**TEACHING PLAN for Academic Year 2020 - 2021**

**PAPER: Calculus**

**SEMESTER: I**

**SESSION: 2020 – 2021 (Odd Semester)**

**TEACHER NAME: Ms. Pooja Khoda**

* **SYLLABUS**

**Unit 1: Derivatives for Graphing and Applications**

The first-derivative test for relative extrema, Concavity and inflection points, second derivative test for relative extrema, Curve sketching using first and second derivative tests; Limits to infinity and infinite limits, Graphs with asymptotes, L’Hopital’s rule; Applications in business, economics and life sciences; Higher order derivatives, Leibniz rule.

**Unit 2: Sketching and Tracing of Curves**

Parametric representation of curves and tracing of parametric curves (except lines in $R^{3}$), Polar coordinates and tracing of curves in polar coordinates; Techniques of sketching conics, Reflection properties of conics, Rotation of axes and second-degree equations, Classification into conics using the discriminant.

**Unit 3: Volume and Area of Surfaces**

Volumes by slicing disks and method of washers, Volumes by cylindrical shells, Arc length, Arc length of parametric curves, Area of surface of revolution; Hyperbolic functions; Reduction formulae.

**Unit 4: Vector Calculus and its Applications**

Introduction to vector functions and their graphs, Operations with vector functions, Limits and continuity of vector functions, Differentiation and integration of vector functions; Modelling ballistics and planetary motion, Kepler's second law; Unit tangent, Normal and binormal vectors, Curvature.

* **COURSE DESCRIPTION/OBJECTIVE**

The primary objective of this course is to introduce the basic tools of calculus and geometric properties of different conic sections which are helpful in understanding their applications in planetary motion, design of telescope and to the real-world problems. Also, to carry out the hand on sessions in computer lab to have a deep conceptual understanding of the above tools to widen the horizon of students’ self-experience.

* **TEACHING TIME(No. Of Weeks): 14 weeks (Approximately)**
* **CLASSES**

The course is organized around daily lectures as per the time table scheduled. Students will be given readings cum notes each week to help them follow the course content. These readings will be discussed in class in detail.

* **WEEK WISE BREAK UP OF SYLLABUS**

**Week 1:** The first-derivative test for relative extrema, Concavity and inflection points, second derivative test for relative extrema, Curve sketching using first and second derivative tests.

[3] Chapter 4 (Section 4.3)

**Week 2**: Limits to infinity and infinite limits, Graphs with asymptotes, Vertical tangents and cusps, L'Hopital's rule.

[3] Chapter 4 (Sections 4.4 and 4.5).

**Week 3:** Applications of derivatives in business, economics and life sciences. Higher order derivatives and Leibniz rule for higher order derivatives for the product of two functions.

[3] Chapter 4 (Section 4.7).

[2] Chapter 5 (Sections 5.1, 5.2 and 5.4).

**Week 4:** Parametric representation of curves and tracing of parametric curves (except lines in $R^{3}$), Polar coordinates and the relationship between Cartesian and polar coordinates.

[3] Chapter 9 [Section 9.4 (Pages 471 to 475)].

[1] Chapter 10 (Sections 10.1, and 10.2 up to Example 2, Page 707).

**Weeks 5 and 6:** Tracing of curves in polar coordinates. Techniques of sketching conics: parabola, ellipse and hyperbola.

[1] Sections 10.2 (Pages 707 to 717), and 10.4 up to Example 10 Page 742)].

**Week 7:** Reflection properties of conics, Rotation of axes, second degree equations and their classification into conics using the discriminant.

[1] Sections 10.4 (Pages 742 to 744) and 10.5.

**Weeks 8 and 9:** Volumes by slicing disks and method of washers, Volumes by cylindrical shells, Arc length, Arc length of parametric curves.

[1] Chapter 5 (Sections 5.2, 5.3 and 5.4).

**Week 10:** Area of surface of revolution; Hyperbolic functions.

[1] Sections 5.5 and 6.8.

**Week 11:** Reduction formulae, and to obtain the iterative formulae for the integrals of the form: $∫sin^{n}x dx$, $∫cos^{n}x dx$, $∫tan^{n}x dx$, $∫sec^{n}x dx$.

[1] Chapter 7 [Sections 7.2 and 7.3 (Pages 497 to 503)].

**Week 12:** Introduction to vector functions and their graphs, Operations with vector functions, Limits and continuity of vector functions, Differentiation and tangent vectors.

[3] Chapter 10 (Sections 10.1 and 10.2 up to Page 504).

**Week 13:** Properties of vector derivatives and integration of vector functions; modelling ballistics and planetary motion, Kepler's second law.

[3] Chapter 10 [Sections 10.2 (Pages 505 to 511) and 10.3].

**Week 14:** Unit tangent, Normal and binormal vectors, Curvature.

[1] Sections 12.4 and 12.5.

* **ASSESSMENT**

**Internal Assessment: 25 Marks (Group Assignment and Class Test)**

* **ESSENTIAL READINGS**
1. Anton, Howard, Bivens, Irl, & Davis, Stephen (2013). Calculus (10th ed.). John Wiley & Sons Singapore Pte. Ltd. Indian Reprint (2016) by Wiley India Pvt. Ltd. Delhi.
2. Prasad, Gorakh (2016). Differential Calculus (19th ed.). Pothishala Pvt. Ltd. Allahabad.
3. Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). Calculus (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011.
* **SUGGESTED READINGS**
1. Thomas, Jr. George B., Weir, Maurice D., & Hass, Joel (2014). *Thomas*’ *Calculus* (13th ed.). Pearson Education, Delhi. Indian Reprint 2017

**PAPER: Group Theory -II**

**SEMESTER: V**

**SESSION: 2020 – 2021 (Odd Semester)**

**TEACHER NAME: Ms. Pooja Khoda**

* **SYLLABUS**

**Unit 1**

Automorphisms and Properties Automorphism, inner automorphism, Automorphism groups, Automorphism groups of finite and infinite cyclic groups, Characteristic subgroups, Commutator subgroup and its properties; Applications of factor groups to automorphism groups.

**Unit 2**

 External and Internal Direct Products of Groups , External direct products of groups and its properties, The group of units modulo *n* as an external direct product, Applications to data security and electric circuits; Internal direct products, Classification of groups of order KC, where K is a prime; Fundamental theorem of finite abelian groups and its isomorphism classes.

**Unit 3**

 **Group Action**

Group actions and permutation representations; Stabilizers and kernels of group actions; Groups acting on themselves by left multiplication and consequences; Conjugacy.

**Unit 4: Sylow Theorems and Applications**

Conjugacy classes, Class equation, K-groups, Sylow theorems and consequences, Applications of Sylow theorems; Finite simple groups, Nonsimplicity tests; Generalized Cayley’s theorem, Index theorem, Embedding theorem and applications.

* **COURSE DESCRIPTION/OBJECTIVE**

The course will develop an in-depth understanding of one of the most

important branch of the abstract algebra with applications to practical real-world problems. Classification of all finite abelian groups (up to isomorphism) can be done.

* **TEACHING TIME (No. Of Weeks): 14 weeks (Approximately)**

**Week 1**: Automorphism, Inner automorphism, Automorphism groups, Automorphism groups of finite and infinite cyclic groups.[2] Chapter 6 (Pages 135 to 138).

**Week 2:** Characteristic subgroups, Commutator subgroup and its properties; Applications of factor groups to automorphism groups. [2] Exercises 1 to 4 on Page 181, and Exercises 62, 68 on Page 204. [2] Chapter 9 (Theorem 9.4 and Example 17).

**Week 3**: External direct products of groups and its properties, The group of units modulo *n* as an external direct product, Applications to data security and electric circuits.[2] Chapter 8.

**Week 4**: Internal direct products, Classification of groups of order KC, where K is a prime. [2] Chapter 9 (Section on internal direct products, Pages 195 to 200).

**Week 5:** Statement of the Fundamental theorem of finite abelian groups, The isomorphism classes of Abelian groups. [2] Chapter 11.

**Weeks 6 and 7:** Group actions and permutation representations; Stabilizers and kernels of group actions. [1] Chapter 1 (Section 1.7), Chapter 2 (Section 2.2) and Chapter 4 (Section 4.1, except cycle decompositions).

**Weeks 8 and 9:** Groups acting on themselves by left multiplication and consequences; Conjugacy. [1] Chapter 4 [Section 4.2 and Section 4.3 (Pages 125-126)].

**Week 10**: Conjugacy classes, Class equation, K-groups. [2] Chapter 24 (Pages 409 to 411).

**Weeks 11 and 12:** State three Sylow theorems and give their applications. [2] Chapter 24 (Pages 412 to 421).

**Weeks 13 and 14:** Finite simple groups, Nonsimplicity tests; Generalized Cayley’s theorem, Index theorem, Embedding theorem and applications; Simplicity of A5. [2] Chapter 25.

* **CLASSES**

The course is organized around daily lectures as per the time table scheduled. Students will be given readings cum notes each week to help them follow the course content. These readings will be discussed in class in detail.

**WEEK WISE BREAK UP OF SYLLABUS**

* **ASSESSMENT**

**Internal Assessment: 25 Marks (Group Assignment and Class Test)**

* **ESSENTIAL READINGS**

**1.Dummit, David S., & Foote, Richard M. (2016). *Abstract Algebra* (3rd ed.). Student Edition. Wiley India.**

**2. Gallian, Joseph. A. (2013). *Contemporary Abstract Algebra* (8th ed.). Cengage Learning India Private Limited. Delhi. Fourth impression, 2015.**

* **SUGGESTED READINGS**

**Rotman, Joseph J. (1995). *An Introduction to The Theory of Groups* (4th ed.) Springer-Verlag, New York.**

**PAPER: Differential Calculus**

**SEMESTER: II**

**SESSION: 2020 – 2021 (Even Semester)**

**TEACHER NAME: Ms. Pooja Khoda**

* **SYLLABUS**

**Unit 1: Differential Equations and Mathematical Modelling**

Differential equations and mathematical models, Order and degree of a differential equation, Exact differential equations and integrating factors of first order differential equations, Reducible second order differential equations, Applications of first order differential equations to acceleration-velocity model, Growth and decay model.

**Unit 2: Population Growth Models**

Introduction to compartmental models, Lake pollution model (with case study of Lake Burley Griffin), Drug assimilation into the blood (case of a single cold pill, case of a course of cold pills, case study of alcohol in the bloodstream), Exponential growth of population, Limited growth of population, Limited growth with harvesting.

**Unit 3: Second and Higher Order Differential Equations**

General solution of homogeneous equation of second order, Principle of superposition for a homogeneous equation; Wronskian, its properties and applications, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler’s equation, Method of undetermined coefficients, Method of variation of parameters, Applications of second order differential equations to mechanical vibrations.

**Unit 4: Analysis of Mathematical Models**

Interacting population models, Epidemic model of influenza and its analysis, Predator-prey model and its analysis, Equilibrium points, Interpretation of the phase plane, Battle model and its analysis.

* **COURSE DESCRIPTION/OBJECTIVE**

The main objective of this course is to introduce the students to the exciting world of differential equations, mathematical modelling and their applications.

* **TEACHING TIME (No. Of Weeks): 14 weeks (Approximately)**
* **CLASSES**

The course is organized around daily lectures as per the time table scheduled. Students will be given readings cum notes each week to help them follow the course content. These readings will be discussed in class in detail.

**WEEK WISE BREAK UP OF SYLLABUS**

**Weeks 1 and 2:** Differential equations and mathematical models, Order and degree of a differential equation, Exact differential equations and integrating factors of first order differential equations, Reducible second order differential equations.

[2] Chapter 1 (Sections 1.1 and 1.6).

[3] Chapter 2.

**Week 3:** Application of first order differential equations to acceleration-velocity model, Growth and decay model.

[2] Chapter 1 (Section 1.4, Pages 35 to 38), and Chapter 2 (Section 2.3).

[3] Chapter 3 (Section 3.3, A and B with Examples 3.8, 3.9).

**Week 4:** Introduction to compartmental models, Lake pollution model (with case study of Lake Burley Griffin).

[1] Chapter 2 (Sections 2.1, 2.5 and 2.6).

**Week 5:** Drug assimilation into the blood (case of a single cold pill, case of a course of cold pills, Case study of alcohol in the bloodstream).

[1] Chapter 2 (Sections 2.7 and 2.8).

**Week 6:** Exponential growth of population, Density dependent growth, Limited growth with harvesting.

[1] Chapter 3 (Sections 3.1 to 3.3).

**Weeks 7 to 9:** General solution of homogeneous equation of second order, Principle of superposition for a homogeneous equation; Wronskian, its properties and applications; Linear homogeneous and non-homogeneous equations of higher order with constant coefficients; Euler’s equation.

[2] Chapter 3 (Sections 3.1 to 3.3).

**Weeks 10 and 11:** Method of undetermined coefficients, Method of variation of parameters; Applications of second order differential equations to mechanical vibrations.

[2] Chapter 3 (Sections 3.4 (Pages 172 to 177) and 3.5).

**Weeks 12 to 14:** Interacting population models, Epidemic model of influenza and its analysis, Predator-prey model and its analysis, Equilibrium points, Interpretation of the phase plane, Battle model and its analysis.

[1] Chapter 5 (Sections 5.1, 5.2, 5.4 and 5.9), and Chapter 6 (Sections 6.1 to 6.4).

* **ASSESSMENT**

**Internal Assessment: 25 Marks (Group Assignment and Class Tests)**

* **ESSENTIAL READINGS**
1. Barnes, Belinda & Fulford, Glenn R. (2015). Mathematical Modelling with Case Studies, Using Maple and MATLAB (3rd ed.). CRC Press, Taylor & Francis Group.
2. Edwards, C. Henry, Penney, David E., & Calvis, David T. (2015). Differential Equation and Boundary Value Problems: Computing and Modeling (5th ed.). Pearson Education.
3. Ross, Shepley L. (2004). Differential Equations (3rd ed.). John Wiley & Sons. India
* **SUGGESTED READINGS**
1. Ross, Clay C. (2004). *Differential Equations*: *An Introduction with Mathematica,* (2nd ed.). Springer.

**PAPER: Ring Theory and Linear Algebra-I**

**SEMESTER: IV**

**SESSION: 2020-2021(even semester)**

**TEACHER NAME: Ms. Pooja Khoda**

* **SYLLABUS**

**Unit 1: Introduction of Rings**

Definition and examples of rings, Properties of rings, Subrings, Integral domains and fields, Characteristic of a ring, Ideals, Ideal generated by a subset of a ring, Factor rings, Operations on ideals, Prime and maximal ideals.

**Unit 2: Ring Homomorphisms**

Ring homomorphisms, Properties of ring homomorphisms, First, Second and Third Isomorphism theorems for rings, The Field of quotients.

**Unit 3: Introduction of Vector Spaces**

Vector spaces, Subspaces, Algebra of subspaces, Quotient spaces, Linear combination of vectors, Linear span, Linear independence, Basis and dimension, Dimension of subspaces.

**Unit 4: Linear Transformations**

Linear transformations, Null space, Range, Rank and nullity of a linear transformation, Matrix representation of a linear transformation, Algebra of linear transformations, Isomorphisms, Isomorphism theorems, Invertibility and the change of coordinate matrix.

* **COURSE DESCRIPTION**

The objective of this course is to introduce the fundamental theory of

two objects, namely - rings and vector spaces, and their corresponding homomorphisms.

* **TEACHING TIME(No. Of Weeks) 14 weeks(Approximately)**
* **CLASSES**

The Course is organized around daily lectures as per the time table scheduled. Students will be given readings cum notes each week to help them follow the course content. These readings will be discussed in class in detail.

* **UNIT WISE BREAK UP OF SYLLABUS**

**Week 1**

 Definition and examples of rings, Properties of rings, Subrings. [1] Chapter 12.

**Week 2**

Integral domains and fields, Characteristic of a ring. [1] Chapter 13.

**Week 3 and 4**

Ideals, Ideal generated by a subset of a ring, Factor rings, Operations on ideals, Prime and maximal ideals.[1] Chapter 14.

**Week 5**

Ring homomorphisms, Properties of ring homomorphisms. [1] Chapter 15 (upto Theorem 15.2).

**Week 6**

First, Second and Third Isomorphism theorems for rings, The field of quotients.[1] Chapter 15 (Theorems 15.3 to 15.6, Examples 10 to 12).

**Week 7**

Vector spaces, Subspaces, Algebra of subspaces.[2] Chapter 1 (Sections 1.2 and 1.3).

**Week 8**

Linear combination of vectors, Linear span, Linear independence.[2] Chapter 1 (Sections 1.4 and 1.5).

**Weeks 9 and 10**

Bases and dimension. Dimension of subspaces. [2] Chapter 1 (Section 1.6).

**Week 11**

Linear transformations, Null space, Range, Rank and nullity of linear transformation.[2] Chapter 2 (Section 2.1).

**Weeks 12 and 13**

Matrix representation of a linear transformation, Algebra of linear transformations.

[2] Chapter 2 (Sections 2.2 and 2.3).

**Week 14**

Isomorphisms, Isomorphism theorems, Invertibility and the change of coordinate matrix. [2] Chapter 2 (Sections 2.4 and 2.5).

**ASSESSMENT**

**Internal Assessment: 25 Marks (Group Assignment and Class Test)**

* **ESSENTIAL READINGS**

1.Gallian, Joseph. A. (2013). *Contemporary Abstract Algebra* (8th ed.). Cengage Learning India Private Limited. Delhi. Fourth impression, 2015.

**2.** Friedberg, Stephen H., Insel, Arnold J., & Spence, Lawrence E. (2003). *Linear Algebra* (4th ed.). Prentice-Hall of India Pvt. Ltd. New Delhi.

* **SUGGESTED READINGS**

1.Dummit, David S., & Foote, Richard M. (2016). *Abstract Algebra* (3rd ed.). Student Edition. Wiley India.

2. Herstein, I. N. (2006). *Topics in Algebra* (2nd ed.). Wiley Student Edition. India.

3. Hoffman, Kenneth, & Kunze, Ray Alden (1978). *Linear Algebra* (2nd ed.). Prentice-Hall of India Pvt. Limited. Delhi. Pearson Education India Reprint, 2015.

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