**TEACHING PLAN for Academic Year 2021 - 2022**

**PAPER: Calculus**

**SEMESTER: I**

**SESSION: 2021 – 2022 (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 Presentation 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: 2021 – 2022 (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.**