



# ARSD College, University of Delhi

## Model Course Handout/Lesson Plan

Course Name : Mathematics Honours						
Semester	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
4	32351403	Ring Theory and Linear Algebra 1	5	1		6
Teacher/Instructor(s) Session		Dr. Pratibha Mehrotra 2021-22				

**Course Objective:** The objective of this course is to introduce the fundamental theory of two objects namely – Rings and Vector Spaces, and their corresponding homomorphisms.

**Course Learning Outcomes:** The course will enable the students to:

1. Learn about the fundamental concepts of Rings, Integral Domains and Fields.
2. Know about Ring Homomorphisms and Isomorphisms theorems of Rings.
3. Learn about the concept of Linear Independence of vectors over a field, and the dimension of a vector space.
4. Basic concepts of linear transformations, dimension theorem, matrix representation of a linear transformation, and the change of coordinate matrix.

### Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
1.	Introduction of Rings	1-2	Definition and examples of Rings
		3-4	Properties of rings
		5-6	Subrings
		7-8	Integral domains and fields
		9-10	Characteristics of a Ring
		11-12	Ideals
		13-14	Ideal generated by a subset of a ring
		15-16	Factor Rings
		17-18	Operation on Ideals
		19-20	Prime and maximal Ideals

2.	Ring Homomorphisms	21--22	Ring Homomorphisms
		23-24	Properties of Ring Homomorphisms
		25	First Theorem of Ring Isomorphism
		26	Second Theorem of Ring Isomorphism
		27	Third Theorem of Ring Isomorphism
		28-30	The Field of Quotients
3.	Introduction of Vector Spaces	31-32	Vector spaces
		33-35	Subspaces
		36-38	Algebra of subspaces
		39-41	Quotient spaces
		42-44	Linear combination of Vectors
		45-47	Linear span and Linear Independence
		48-50	Basis and dimension, Dimension of Subspaces
4.	Linear Transformation	5-52	Linear Transformations
		53-54	Null spaces
		55-56	Range
		57-58	Rank and Nullity of a linear transformation
		59-60	Matrix representation of a linear transformation
		61-62	Algebra of linear transformations
		63-65	Isomorphisms
		66-68	Isomorphism Theorems
		69-70	Invertibility and the change of coordinate matrix

#### Evaluation Scheme:

No.	Component	Duration	Marks
1.	Internal Assessment		25
	• Quiz		
	• Class Test		
	• Attendance		
	• Assignment		
2.	End Semester Examination	3 hr	75

#### Details of the Course

Unit	Contents	Contact Hours
1	<b>Introduction of Rings</b> 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.	10
2	<b>Ring Homomorphisms</b> Ring homomorphisms, Properties of ring homomorphisms, First, Second and Third Isomorphism theorems for rings, The Field of quotients.	20
3	<b>Introduction of vector spaces</b>	20

	Vector spaces, Subspaces, Algebra of subspaces, Quotient spaces, Linear combination of vectors, Linear span, Linear independence, Basis and dimension, Dimension of subspaces.	
4	<b>Linear Transformations</b> 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.	20
	<b>Total</b>	<b>70</b>

**Suggested Books:**

Sl. No.	Name of Authors/Books/Publishers	Year of Publication/Re print
1-	Joseph A. Gallian	2013
2	Friedberg, Stephen H.	2003
3.	Herstein, I. N.	2006
<b>Mode of Evaluation:</b>		Internal Assessment / End Semester Exam

**Progress Report:**

Unit No.	Learning Objective	Date	Topics to be covered
1.	Introduction of Rings		Definition and examples of Rings
			Properties of rings
			Subrings
			Integral domains and fields
			Characteristics of a Ring
			Ideals
			Ideal generated by a subset of a ring
			Factor Rings
			Operation on Ideals
			Prime and maximal Ideals
2.	Ring Homomorphisms		Ring Homomorphisms
			Properties of Ring Homomorphisms
			First Theorem of Ring Isomorphism
			Second Theorem of Ring Isomorphism
			Third Theorem of Ring Isomorphism
			The Field of Quotients

3.	Introduction of Vector Spaces		Vector spaces
			Subspaces
			Algebra of subspaces
			Quotient spaces
			Linear combination of Vectors
			Linear span and Linear Independence
			Basis and dimension, Dimension of Subspaces
4.	Linear Transformation		Linear Transformations
			Null spaces
			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