

	P.R.Government College (Autonomous) KAKINADA	Program&Semester II B.Sc. (III Sem)			
Course Code MAT-301/3201	TITLE OF THE COURSE Abstract Algebra				
Teaching	Hours Allocated: 60 (Theory)	L	T	P	C
Pre-requisites:	Basic Mathematics Knowledge on sets and number system.	4	1	-	4

Course Objectives:

To provide the learner with the skills, knowledge and competencies to carry out their duties and responsibilities in pure Mathematic environment.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Acquire the basic knowledge and structure of groups, subgroups and cyclic groups.
CO2	Get the significance of the notation of a normal subgroups.
CO3	Understand the ring theory concepts with the help of knowledge in group theory and to prove the theorems.
CO4	Study the homomorphisms and isomorphisms with applications.

Course with focus on employability/entrepreneurship /Skill Development modules

Skill Development		Employability		Entrepreneurship	
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UNIT I :

(12 Hours)

GROUPS : Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group, Composition tables with examples.

UNIT II:

(12 Hours)

SUBGROUPS:Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition- examples-criterion for a complex to be a subgroups. Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups. **Co-sets and Lagrange’s Theorem:** Cosets Definition-properties of Cosets–Index of a subgroups of a finite groups–Lagrange’s Theorem.

UNIT III:

(12 Hours)

NORMAL SUBGROUPS: Definition of normal subgroup – proper and improper normal subgroup– Hamilton group – criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups – Sub group of index 2 is a normal sub group –quotient group – criteria for the existence of a quotient group.

HOMOMORPHISM : Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – automorphism definitions and elementary properties–kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

UNIT IV:

(12 Hours)

PERMUTATIONS: Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley’s theorem.

UNIT V:

(12 Hours)

RINGS

Definition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws Rings,Integral Domains, Division Ring and Fields, The characteristic of a ring - The characteristic of an Integral Domain, The characteristic of a Field. Sub Rings.

Co-Curricular Activities(15 Hours)

Seminar/ Quiz/ Assignments/ Group theory and its applications / Problem Solving.

TEXT BOOK :

1. A text book of Mathematics for B.A. / B.Sc. by B.V.S.S. SARMA and others, published by S.Chand & Company, New Delhi.

REFERENCE BOOKS :

1. Abstract Algebra by J.B. Fraleigh, Published by Narosa publishing house.
2. Modern Algebra by M.L. Khanna.
3. Rings and Linear Algebra by Pundir & Pundir, published by Pragathi Prakashan.

Additional Inputs :

Cyclic Groups, Maximal Ideals and Prime Ideals .

CO-PO Mapping:

(1:Slight[Low];

2:Moderate[Medium];

3:Substantial[High],

'-':NoCorrelation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
C01	3	3	2	3	3	2	1	2	2	3	2	3	2
C02	3	2	3	3	2	3	3	1	3	3	3	2	1
C03	2	3	2	3	2	3	2	2	2	3	2	2	3
C04	3	2	3	2	2	2	3	3	1	1	3	1	2

BLUE PRINT FOR QUESTION PAPER PATTERN

SEMESTER-III

Unit	TOPIC	S.A.Q	E.Q	Marks allotted to the Unit
I	Groups	2	2	20
II	Subgroups , Co-sets and Lagrange's Theorem	2	1	20
III	Normal subgroups, Homomorphism	1	1	15
IV	Permutations.	1	1	15
V	Rings	1	1	15
Total		7	6	95

S.A.Q. = Short answer questions (5 marks)

E.Q = Essay questions (10 marks)

Short answer questions : 4 X 5 = 20 M

Essay questions : 3 X 10 = 30 M

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Total Marks = 50 M

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P.R. Government College (Autonomous), Kakinada
II year B.Sc., Degree Examinations - III Semester
Mathematics Course: Abstract Algebra
Paper III (Model Paper w.e.f. 2023-24)

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Time: 2Hrs

Max. Marks: 50

SECTION-A

Answer any three questions. Selecting at least one question from each part

Part – I

3 X 10 = 30

1. A finite semi –Group $(G, \cdot)$ satisfying the cancellation laws is a group.
2. Show that the set Q_+ of all positive rational numbers forms an abelian group under the composition defined by ‘ $\circ$ ’ such that $a \circ b = (ab)/3$ for $a, b \in Q_+$
3. Prove that a non empty complex H of a group G is a subgroup of G if and only if $a, b \in H \Rightarrow ab^{-1} \in H$.

Part – II

4. State and prove fundamental theorem on homomorphisms of groups
5. State and prove Cayley’s theorem.
6. Prove that the ring of integers Z is a principal ideal ring.

SECTION-B

Answer any four questions

4 X 5 M = 20 M

7. Prove that in a group $G (\neq \emptyset)$, for $a, b, x, y \in G$, the equations $ax = b, ya = b, \forall a, b \in G$ have unique solutions.
8. If G is a group, for $a, b \in G$ prove that $(ab)^{-1} = b^{-1}a^{-1}$
9. If a non-empty complex H of a group G is a subgroup of G then prove that $H = H^{-1}$.
10. If G is a finite group and $a \in G$ then show that $O(a)$ divides $O(G)$.
11. Define Normal subgroup. Prove that a subgroup H of a Group $(G, \cdot)$ is a normal subgroup of G if and only if $xHx^{-1} = H \forall x \in G$.
12. Verify whether the permutation $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 2 & 5 & 4 & 3 & 6 & 1 & 7 & 9 & 8 \end{pmatrix}$ is even or odd.
13. Prove that, a ring R has no zero divisors iff the cancellation laws hold in R .

	P.R. Government College (Autonomous) KAKINADA	Program&Semester II B.Sc. (III Sem)			
Course Code MAT-301P	TITLE OF THE COURSE Abstract Algebra				
Teaching	Hours Allocated: 30 (Practicals)	L	T	P	C
Pre-requisites:	Basic Mathematics Knowledge on sets and number system.	-	-	2	1

UNIT I : (12 Hours)

GROUPS : Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group, Composition tables with examples.

UNIT II: (12 Hours)

SUBGROUPS: Complex Definition – Multiplication of two complexes Inverse of a complex- Subgroup definition- examples-criterion for a complex to be a subgroups. Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups. **Co-sets and Lagrange's Theorem:** Cosets Definition-properties of Cosets-Index of a subgroups of a finite groups-Lagrange's Theorem.

UNIT III: (12 Hours)

NORMAL SUBGROUPS: Definition of normal subgroup – proper and improper normal subgroup– Hamilton group – criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups – Sub group of index 2 is a normal sub group –quotient group – criteria for the existence of a quotient group.

HOMOMORPHISM : Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – automorphism definitions and elementary properties–kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

UNIT IV: (12 Hours)

PERMUTATIONS: Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.

UNIT V: (12 Hours)

RINGS

Definition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws Rings, Integral Domains, Division Ring and Fields, The characteristic of a ring - The characteristic of an Integral Domain, The characteristic of a Field. Sub Rings.

TEXT BOOK :

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Semester – III End Practical Examinations

Scheme of Valuation for Practical's

Time : 2 Hours

Max.Marks : 50

- **Record - 10 Marks**
- **Viva voce - 10 Marks**
- **Test - 30 Marks**
- **Answer any 5 questions. At least 2 questions from each section. Each question carries 6 marks.**

BLUE PRINT FOR PRACTICAL PAPER PATTERN

COURSE-III, ABSTRACT ALGEBRA

Unit	TOPIC	E.Q	Marks allotted to the Unit
I	Groups	2	12
II	Sub groups Co-sets and Lagrange's Theorem	2	12
III	Normal subgroups, Homomorphism	2	12
IV	Permutations	1	06
V	Rings	1	06
	Total	08	48

P.R. GOVT. COLLEGE (AUTONOMOUS), KAKINADA
Ilyear B.Sc., Degree Examinations - III Semester
Mathematics Course-III: ABSTRACT ALGEBRA
(w.e.f. 2022-23 Admitted Batch)
Practical Model Paper (w.e.f. 2022-2023)

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Time: 2Hrs

Max. Marks: 50M

Answer any 5 questions. At least 2 questions from each section.

5 x 6 = 30 Marks

SECTION - A

1. Show that the set of rational numbers other than 1 with operation $*$ such that $a * b = a + b - ab \forall a, b \in \mathbb{Z}$ is an abelian groups.
2. Prove that a finite semi-group $(G, \cdot)$ satisfying the cancelation laws is a group
3. Prove that a non empty complex H of a group G is a subgroup of G if and only if $a, b \in H \Rightarrow ab^{-1} \in H$, where b^{-1} is the inverse of b in G .
4. If H and K be two sub-groups of a group g then $H \cup K$ is a sub-group iff either $H \subseteq K$ or $K \subseteq H$

SECTION – B

5. Prove that H is a normal sub-group of G if and only if product of two right right (left) cosets of H in G is again a right (left) coset of H on G .
6. Prove that a sub-group of index 2 in a group is a normal sub-group.
7. $f = (1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \ 8)$, $g = (4 \ 1 \ 5 \ 6 \ 7 \ 3 \ 2 \ 8)$ are cyclic permutations. Show that $(fg)^{-1} = g^{-1}f^{-1}$.
8. Prove that the set $Z(i) = \{a + ib : a, b \in \mathbb{Z}, i^2 = -1\}$ of Gaussion integers is an Integral domain with respect to addition & multiplication of numbers is a field.

➤ **Record** - 10 Marks

➤ **Viva voce** - 10 Marks