DEPARTMENT - MATHEMATICS

Course Pack
FOR
ALGEBRA-MAT431

MAT431 - ALGEBRA

Total Teaching Hours For Semester : 60   **Total Teaching Hours For Semester : 4**

Max Marks : 100   **Credits : 4**

Course Objectives/Course Description:

This course aims at developing the ability to write the mathematical proofs. It helps the students to understand and appreciate the beauty of the abstract nature of mathematics and also to develop a solid foundation of theoretical mathematics.

Learning Outcome

On successful completion of the course, the students should be able to

Describe and generate groups, rings and fields

Relate abstract algebraic constructs to more familiar sets and operators

Identify and differentiate different structures and understand how changing properties give rise to new structures

Demonstrate some simple applications related to group of symmetries

Understand concepts of commutative rings, integral domains, ring homomorphism and factorization theorem of commutative rings

Unit-1   **Teaching Hours:15**

Groups

 Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n and the group U(n) of units under multiplication modulo n, complex roots of unity, groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square.

Unit-2   **Teaching Hours:25**

Subgroups and Group Homomorphism's

 Subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. order of an element, cyclic subgroups, Cosets, Index of subgroup, Lagrange's theorem, consequences of Lagrange's theorem, Normal subgroups: their definition, examples, and characterizations, Quotient groups, Cauchys theorem for finite abelian groups, permutation groups and Symmetric groups – Homomorphism of groups – Kernel of group homomorphisms and theorems thereon – Fundamental theorem of homomorphism of group.

Unit-3   **Teaching Hours:20**

Rings, Integral Domain and Fields

Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of

fields: Z_p, Q, R, and C. Field of rational functions.

Text Books And Reference Books:

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. I N Herstein , Topics in Algebra, Second Edition. Wiley India (P) Ltd.New Delhi, India: Vikas Publishing House Pvt. Ltd, 2006.
3. Joseph A Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa, 2000.

Essential Reading / Recommended Reading:

M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
S.R. Nagpaul and S.K.Jain, Topics in Applied Abstract Algebra, Universities Press, 2010.

Additional Information

ESE - FORMAT OF QUESTION PAPER

Part	Unit and No. of subdivisions to be set in the unit		No. of subdivisions to be answered	Marks for each subdivision	Max. marks for the part
A	Unit I	3	8	3	24
	Unit II	5			
	Unit III	4			
B	Unit I	2	7	8	56
	Unit II	4			
	Unit III	3			
C	Unit I	1	2	10	20
	Unit II	1			
	Unit III	1			
Total					100

Evaluation Pattern

Component	Mode of Assessment	Parameters	Points
CIA I	MCQ, Written Assignment. Reference work	Mastery of the core concepts Problem solving skills	10
CIA II	Mid-semester Examination	Basic, conceptual and analytical knowledge of the subject	25
CIA III	Assignment / Written Assignment	Written Assignment based on Sequences and Series	10
Attendance	Attendance	Regularity and Punctuality	05
ESE		Basic, conceptual and analytical knowledge of the subject	50
		Total	100

COURSE PLAN TEMPLATE (Theory)

SECTION I

Class	BSc.	Semester	IV
Course title	Algebra	Course Code	MAT431
Hours	60hrs	Hours per week	4hrs
Faculty name	Dr. TV JOSEPH (PCM) Dr. GANGADHAR S K (EMS/CMS) Dr. TABITHA RAJASHEKAR (PME) Dr. CHARLES DOMINIC (CME)	Contact details	joseph.tv@christuniversity.in gangadhar.sk@christuniversity.in tabitha.rajashekar@christuniversity.in charles.dominic@christuniversity.in
Class policies and guidelines	• Attendance will be taken with in the first 10 minutes. Latecomers will not be entertained for attendance. • Usage of Laptop / mobile phone / Head phones inside the class is strictly prohibited. However, during the demo / practice sessions students will be permitted to use their Laptop. • All the information will be communicated through LMS		
Course Description	This course aims at developing the ability to write the mathematical proofs. It helps the students to understand and appreciate the beauty of the abstract nature of mathematics and also to develop a solid foundation of theoretical mathematics.		

Course Objectives	1. Developing a respectable intellectual level seeking to expose the various concepts in mathematics. 2. To cultivate a mathematicians habit of thought and reasoning. 3. To enlighten the student that the mathematical ideas are relevant for oneself no matter what his/her interests are. 4. Development of students' competence by evolving a learner-centered curriculum. 5. To encourage the students to uphold scientific integrity and objectivity in professional endeavours.
Course Outcomes	*Understand different types of group and proving Lagrange's theorem* *Define the centre, normalizers and normal subgroups and proving Isomorphism theorems* *State and prove the fundamental theorem of finite Abelian groups* *Define a ring, subring, quotient ring, integral domain and field and hence able to prove theorems on them.*

SECTION II

Unit	Unit details	Week (starting and end dates)	Hours per week	Pedagogy (teaching learning methods used)/ activities and or class trips/ dates for assessment	Resource/ Reference details
Unit 1	**GROUPS:** Definitions and examples of groups, examples	12/11/2018 to 17/11/2018	3	Lecture and Discussion	• I N Herstein , *Topics i n Algebr a* , Secon d Edition. W i l e y I n d i a (P) Ltd.Ne w D e l h i , I n d i a : V i k a s Publish i n g House P v t . L t d , 2 0 0 6 . • J A Gallian , *Conte mporar y Abstra c t Algebr a*, 8th e d . , Narosa B o o k s Distrib
	Examples of abelian and non-abelian	19/11/2018 to 24/11/2018	4	Lecture and Discussion	
	The group Z of integers under addition modulo n and group U(n) of units under multiplication modulo n, complex roots of unity	26/11/2018 to 01/12/2018	4	Lecture and Discussion	
Unit 2	**Subgroups** Definition, properties and theorems.	3/12/2018 To 8/12/2018	4	Lecture and Discussion	
	Centre of a group.	10/12/2018 To 15/12/2018	4	Lecture and Discussion	
	Order of an element, Cyclic groups from number systems	17/12/2018 To 22/12/2018	4	Lecture and Discussion	
	Cosets, Index of subgroup	02/01/2019 To 05/01/2019	3	Lecture and Discussion	
	Lagrange's theorem and Normal Subgroup	07/01/2019 To 11/01/2019	2	Lecture and Discussion	
	Normal Subgroup: their definition, examples and characterizations,	21/01/2019 To 26/01/2019	4	Lecture and Discussion	

	Cauchy's theorem for finite abelian groups	28/01/2019 To 02/02/2019	4	Lecture and Discussion	u t i o n Private L t d . , 2 0 1 2 .
	Permutation groups and Symmetric groups	04/02/2019 To 09/02/2019	4	Lecture and Discussion	• M A r t i n , *Abstra c t Algebr a,* 2nd E d . , Pearso n,2011

Unit 3	Rings, Integral Domain and Fields: Definition and examples of rings	11/02/2019 To 16/02/2019	4	Lecture and Discussion	
	examples of commutative and non-commutative rings: rings from number systems,	18/02/2019 To 23/02/2019	4	Lecture and Discussion	
	Z the ring of integers modulo n, ring of real quaternions, ring of matrices	25/02/2019 To 02/03/2019	4	Lecture and Discussion	
	Subrings and Ideals	04/03/2019 To 09/03/2019	4	Lecture and Discussion	
	Integral domains and Fields-Results and examples and theorems.	11/03/2019 To 22/03/2019	4	Lecture and Discussion	

SECTION III

Assessment outline:

CIA I - A	CIA -I B	CIA II	CIA III	Attendance	ESE
5%	5%	25%	10%	5%	50%

Mapping: A template to map the Learning Outcomes of the course against the components of assessment is given below:

Course Outcomes	Components of assessment				
	CIAI-A	CIAI-B	CIAII	CIAIII	ESE
CO 1					
CO 2					
CO 3					
CO 4					

SECTION IV

Assessment Description:

Component I: Online Test (CIA -1A) (before 15/12/2018)

*This online test with multiple choice/descriptive questions is
meant to assess students' knowledge and understanding of core concepts of
Unit 1 of the syllabus along with their problem solving skills.*
Max Marks:20Marks
Max Time:20min
There will be 10 questions of 2 m each .
Learning outcomes:

On successful completion of this assignment, student will be able to
- Have Conceptual clarity on groups, subgroups, normal group and related results.

- Identify applications of Rings, subrings, homomorphism and isomorphism.

Assessment Strategies aligned to LO: Online Quiz Technology Tools used along with their Purpose: LMS - Quiz
Evaluation Rubrics
   Each question carries 2m.Evaluation scale: *2m: Right answer, 0m: Wrong answer*

   Mapping the Learning Outcomes of the assignment with components of the evaluation rubrics:

Learning Outcomes of the assignment	Method of assessment	Component of the evaluation rubrics
LOI	Test	Problem Solving
LO 2	Test	Conclusion of Results and Theorems

Component II: Review of Research Paper (CIA – 1B) (before 26/01/2019)

Students are adviced to submit an assignment (Report) on review of paper
related to Groups. This is group assignment. Each group consist of 4
students. References should be in the IEEE style. Plagiarism will not be entertained; if
found the student will be asked to resubmit the assignment

Assignment Learning Objectives: After the completion of the assignment,
 Students will
   Define the concept used in the assignment mathematically.
   Illustrate with a relevant example the concept selected resulting in improvement
   of basics, conceptual and analytical knowledge.
   Evaluate the mathematical problem to get the required result.
   Interpret the result obtained.
   Develop Self learning.
   Have research orientation
Assessment Strategies aligned to LO: Asssignment (Report)
 Technology Tools used along with their Purpose: Offline

<u>**Rubrics**</u>*:*

Assignment should contain the following:
   Introduction

Conceptualization
Applications and Significant Results
Conclusion
References are to be given in IEEE format

2 0	*Assignment is complete* *Assignment answer are extremely accurate* *Assignment is submitted on time* *Assignment is legible* *Assignment is submitted in the prescribed format*
1 6	*Assignment is mostly complete* *Assignment is almost accurate* *Assignment is submitted on time* *Assignment is legible* *Assignment is submitted in the prescribed format.*
1 4	*Assignment is partially complete* *Assignments answers are partially accurate* *Assignment is submitted late (1 day)* *Assignment is somewhat legible* *Assignment is submitted in the prescribed format*
1 0	*Assignment is mostly incomplete* *Assignments answers are mostly incorrect* *Assignment is submitted late (more than 1 day)* *Assignment is somewhat legible* *Assignment is not submitted in the prescribed format*
0	*Non submission of Assignment*
	Plagiarism will attract resubmission and reduction in marks

Mapping the Learning Outcomes of the assignment with components of the evaluation rubrics:

Learning Outcomes of the assignment	Method of assessment	Component of the evaluation rubrics
LO 1	Assignment	Introduction and Review of the article
LO 2	Assignment	Conclusion and Results

CIA-III

Component I: Project   (before 20/02/2019)

Project Description

This project is to design a mathematical model to solve a real life problem.

Elaborate any one application based on concepts of Mathematics using a model and present it to the evaluators.

This is a group project. Each group consists of minimum of 2 and maximum of 3 people.

Project Learning Objectives

Define the concept used in the project mathematically.
Illustrate with a relevant example the concept selected.
Identify a real life problem using the concept.
Formulate the problem mathematically
Evaluate the mathematical problem to get the required result using a model.
Interpret the result obtained.

4. Assignment Design

Assignment Learning Objectives	Assessment Strategies aligned to LO		
Define the concept used in the assignment mathematically and illustrate with a relevant example the concept selected.	correct definition 2marks	In complete definition 1 mark	In correct definition 0 mark
Identify a real life problem using the concept.	Relevant problem identified 2 marks	problem not identified 0 mark	

Formulate the problem mathematically	Identify, Relate, Specify and Formulate the problems 4 marks	Identifying the variables and describe the relation between variables and specify the assumptions involved 3marks	Identifying the variables and describe the relation between variables 2 marks	Identifying the variables 1 marks		
Evaluate the mathematical problem to get the required result using a model.	Correct solution 6 marks	Error at the last stage 5 marks	Error at the second stage 4 marks	Error at the first stage 3marks	Method and formula 2 marks	Relevant method identified 1marks
Interpret the result obtained.	4 Interpretation 4 marks			3 Interpretation 3marks	2Interpretation 2 marks	1 Interpretation 1 mark

Component 2: Class Test (before 15/03/2019)

This test with descriptive questions is meant to assess students' knowledge and understanding of core concepts of Unit III of the syllabus along with their problem solving skills.
Max Marks:20Marks
Max Time:45min
There will be 4 questions of 5 marks each.
Evaluation Rubrics
    Each question carries 5m.
    Evaluation scale:
        5m: Right answer,
        4m: Partially correct, but not completely
        3m: Partially correct with major mistakes
        2m: Identification of concept 0m: Wrong answer
    Mapping the Learning Outcomes of the assignment with components of the evaluation rubrics:

Learning Outcomes of the assignment	Method of assessment	Component of the evaluation rubrics
LOI	Report	Self Learning and Writing Skills
LO 2	Presentation	Presentation skills