Government PG College, Ambala Cantt.

Course File (Session 2023-24)

Name of Assistant Professor: Dr. Hardish Kaur

Class: B.SC. /B.A. I Year/2nd Semester

Course Code and Name: B23-MAT 201 Algebra and Number Theory

Name of Assistant Professor: Dr. Hardish Kaur

Instructions for Paper- Setter

The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will contain 5 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question.

I. Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices, Elementary operations on matrices, Rank of a matrix, Inverse of a matrix, Linear dependence and independence of rows and columns of matrix, Row rank and column rank of a matrix, Eigen values, Eigen vectors and characteristic equation of a matrix, Minimal polynomial of a matrix, Cayley-Hamilton theorem and its use ni finding the inverse of a matrix, Unitary and orthogonal matrices.

II. Relations between the roots and coefficients of general polynomial equation ni one variable, Solutions of polynomial equations having conditions on roots, Common roots and multiple roots, Transformation of equations, Nature of the roots of an equation, Descarte's rule of signs.

III. Solutions of cubic equations (Cardon's method), Biquadratic equations and their solutions. Divisibility, Greatest common divisor (gcd), Least common multiple (Icm), Prime numbers, Fundamental theorem of arithmetic, Wilson's theorem and its converse, Chinese Remainder theorem, Linear Diophantine equations in two variables.

IV. Linear congruences, Fermat's theorem, Euler's theorem, Wilson's theorem and its converse, Chinese Remainder theorem, Lniear Diophantine equations in two variables.

Practical

The practical component of the course has two parts, Problem Solving and Practical's using MAXIMA software. The examiner will set 4 questions at the time of practical examination asking two questions from the part (A) and two questions from the part (B) by taking course learning outcomes (CLOs) into consideration. The examinee will be required to solve one problem from the part (A) and to execute one problem successfully from the part (B). Equal weightage will be given to both the parts. The evaluation will be done on the basis of practical record, viva-voce, write up and execution of the program.

A) Problem Solving: Questions related to the following problems will be worked out and record of those will be maintained in the Practical Notebook:

1. Problems to find the row rank and column rank of a matrix.

2. Problems to find the eigen values and eigen vectors of a matrix.

3. Problems to find the minimal polynomial of a matrix.

4. Problems of finding inverse of a matrix using Cayley- Hamilton theorem.

5. Problems of solving cubic equations by Cardon's method.

6. Problems of solving biquadratic equations by Descarte's method.

7. Problems of solving biquadratic equations by Ferrari's method.

8. Problems to find gcd and lcm of two integers.

9. Problems to find solution of linear congruence using Euler's theorem.

10. Problems to find common solution of congruences using Chinese remainder theorem.

B) The following practicals will be done using MAXIMA Software and their record will be maintained in the practical note Book:

1. To find roots of algebraic equations using MAXIMA.

2. To find multiple roots of algebraic equations using MAXIMA

3. To find the value of a determinant using MAXIMA.

4. To compute inverse of a square matrix using MAXIMA.

5. To find Eigen values of a square matrix using MAXIMA.

6. To find Eigen vectors of a square matrix using MAXIMA.

7. To solve system of linear equations using MAXIMA.

8. Problems to find gcd and lcm of two or more integers using MAXIMA.

9. Problems of solving biquadratic equations by Ferrari's method using MAXIMA.

Lesson Plan: From February 2024 to May 2024

10 Feb to 15 Feb	Matrices
16 Feb to 29 Feb	orthogonal and unitary matrices
1 March to 15 March	Rank of a matrix, Eigen values
16 March to 22 March	Relation b/w the roots and coefficients of equation
23 March to 31 March	Holi Break
1 April to 15 April	Transformation of equations, Descarte's rule of sign, Solution of cubic and biquadratic equations
16 April to 30 April	Divisibility, Congruences
1 May to 15 May	Fermat's, Euler's,Wilson's, Chinese Remainder theorem
Revision and Practice tests	

Course Learning Outcomes:

After completing this course, the learner will be able to:

1. Gain knowledge of the concepts of symmetric, skew-symmetric, Hermitian, skew-Hermitian, Orthogonal and Unitary matrices, Linear dependence and independence of rows and columns of a matrix. Have knowledge of procedure and cognitive skills used in calculating rank of a matrix, eigen values, characteristic equation, minimal polynomial of a matrix and technical skills used in solving problems based on Cayley- Hamilton theorem.

2. Have knowledge of concepts used in solving problems based on relations between the roots and coefficients of general polynomial equation in one variable, solutions of polynomial equations having conditions on roots, common roots and multiple roots. Understand Descarte's

rule of signs and learn cognitive and technical skills required in assessing nature of the roots of an equation and solving problems based on these.

3. Have deeper and procedural knowledge required for solving cubic and biquadratic equations used in Mathematics as well as many other learning fields of study. To understand the basic concepts of number theory and their applications in problem solving and life- long learning.

4. Have knowledge of concepts, facts, principles and theories of Linear Congruences, Fermat's theorem, Euler's theorem, Wilson's theorem and its converse, Chinese Remainder theorem. Attain cognitive skills used in solving linear Diophantine equations in two variables.

Recommended Books/e-resources:

1) Stephen H. Friedberg, Arnold .J Insel & Lawrence E. Spence (2022). Linear Algebra (5 edition). Prentice Hal of India Pvt. Ltd.

2) Seymour Lipschutz and Marc Lars Lipson (2013). Linear Algebra. (4th Edition) Schaum's Outline Series, McGraw-Hill.

3) K. B. Dutta (2004). Matrix and Linear Algebra. Prentice Hal of India Pvt. Ltd.

4) Vivek Sahai & Vikas Bist (2013). Linear Algebra (2'" edition). Narosa Publishing House.

5) I. Niven (1991). An Introduction to the Theory of Numbers (5th edition). John Wiley & Sons.

6) H.S. Hal and S.R. Knight (2023). Higher Algebra (7 edition). Arihant Publications.)

7 Leonard Eugene Dickson (2009). First Course ni hte Theory of Equations. The Project Gutenberg EBook (http://www.gutenberg.org/ebooks/29785).