

Course Objective: The student should be able to read and understand the initial research papers in the area of algebraic graph theory, especially spectral graph theory.

Course contents: Basic results on system of linear equations, Cauchy-Binet formula for computing determinant, Rank factorization of a singular matrix, Vector Spaces associated with a matrix, Different types of generalized inverses, Moore-Penrose Inverse. Spectral Theorem of symmetric matrices, algebraic and geometric multiplicities, characteristic and minimal polynomials, Courant-Fischer Theorem, Interlacing theorems for eigenvalues, Quadratic forms, Positive definite matrices and its characterizations. Graphs, digraphs, examples, sub-graphs, simple graphs, emphasis on tree, cycle graph and complete graph/bipartite graphs, complement of a graphs, path, walk and cycle in a graph. Definition, example, rank and minor of $\{0, 1, -1\}$ -incidence matrix, Substructure of a graph, Path-matrix and Moore-Penrose inverse of incidence matrix. Adjacency matrix, relationship with number of edge/walks/..., eigenvalues of certain graphs, Determinant in terms of cycles and edges, Bounds on the spectrum of adjacency matrix, Laplacian matrix of a graph, it's properties, Matrix Tree theorem, Bounds on Laplacian spectral radius, Perron Frobenius theory, Basic results on Regular and Strongly regular graphs, Algebraic connectivity, Fiedler's theorems, Bounds on algebraic connectivity.

Instructor: A. K. Lal

Time: M Th 12:00 13:15

Class Room: TB 203

Course Organization: All notices related to course will be sent by email to the course email list.

Home Assignments: Since this is a research level course, home assignments will not be given. The exercises given in the class and proofs left incomplete should be considered as home assignments.

Attendance: Attendance is compulsory. If your attendance falls short by 10% then you will not be allowed to appear for the end semester examination. If you are granted leave by SUGC or SPGC, chairperson, you must inform the instructor.

Exams, quizzes and seminars: There will be one mid-sem exam, one end-sem exam and one seminar by each student. The quizzes will be unannounced. The seminar will be of around 20-30 minutes duration and will be held in the evening, starting October 01, 2017. The attendance in the seminar is not compulsory.

For seminar, you can pick up any material that uses positive (semi) definite matrices or non-negative matrices from any research paper or any topic from the book "Algebraic graph theory by either Norman Biggs or by Chris Godsil and Gordon Royle" or the book "Topics in Algebraic graph theory by Lowell W Beineke and Robin J Wilson".

The weightage is as follows: Quiz – 10%, Seminar – 30%, Exams – 30% each.

Grading: you will surely get an A-grade if you get above 75% marks, B if your marks is between 60-74%, C if your marks is between 45-59% and D if your score is between 30-44%. But, I may go down depending on the overall performance.

Books: I will be following the book "Graphs and Matrices by R B Bapat", "Algebraic graph theory by either Norman Biggs or by Chris Godsil and Gordon Royle".