

Indian Statistical Institute
II Semestral Examination 2008-2009
B.Math. Hons.III year
Combinatorics and Graph Theory (Back Paper)
Date:00-00-2009 Duration: 3 Hours Instructor: N.S.N.Sastry
Max Marks 100

Answer all questions. Your answer should be complete.

1. Define the parameters of a strongly regular graph. Obtain the eigen values, and their multiplicities, of a strongly regular graph in terms of its parameters. [3 + 7]
2. Let P_r , $0 \leq r \leq n - 1$, be the set of $(r + 1)$ dimensional subspaces of \mathbb{F}_q^{n+1} ($n \geq 2$). Find the largest t for which the following is a t -design:
(i) (P_0, P_2) (ii) (P_1, P_2)
Compute the parameters in each case. (In both the cases, inclusion is the incidence relation.) [8 + 8]
3. Define the weight enumerator polynomial of a linear code. Deduce a relation between the weight enumerator polynomial of a linear code C and that of its dual code C^\perp . [4 + 10]
4. a) Let $\mathbb{D} = (X, \mathbb{B})$ be a $t(v, k, \lambda)$ design. Show that $\mathbb{D}^1 = (X, \{X \setminus B : B \in \mathbb{B}\})$ is also a t -design. Compute its parameters.
b) If a group acts faithfully on the point-set of a 2-design, then show that its action on the set of blocks is also faithful. [8 + 8]
5. a) Define a projective plane of order n . Show that there exists a projective plane of order q for each prime power q .
b) Define an affine plane of order n . Show that a projective plane of order n exists if, and only if, an affine plane of order n exists. [3 + 4 + 3 + 8]
6. a) Define a Hadamard design. Obtain the parameters of a Hadamard design.
b) Show that a Hadamard design is extendable. [9 + 9]
7. Define a maximum distance separable code. Show that the dual of a maximum distance separable code is also a maximum distance separable code. [4 + 6]

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