① Final exam

Structure like the midterm

3 sections each with 6e questions

447 do 4 from each sectio

747 do 5 from ay 2 sections
4 from te othe

Covers the entire semester

~ $\frac{1}{3}$ on material from before te midterm

~ $\frac{2}{3}$ on material afte

What room is te exa in.

Still not schedded → I will email as soon as I know either in AQ 5016 or there will be a sign on that room

Update: room is in fact AQ5016

② Review

ch 1 **block codes**

hamming distance

q-ary symmetric channels, nearest neighbor decoding and maximum likelihood decoding and when they're equivalent

spheres around codewords and how many errors a code with a given distance can correct and detect

ch 3 **linear codes**

vector spaces over finite fields

message space

codes as subspaces — linear codes, (n,k)-codes

distance and weight

generator matrices

standard form $[I\ A]$

equivalent codes

orthogonal complements of vector spaces over finite fields

dual codes

parity check matrices

Thm H parity check matrix for (n,k)-code C over $\mathbb{F}_q$
then any set of $s-1$ cols of H is lin ind
iff C has distance $\geq s$

1-error correcting

Hamming codes

perfect codes

decoding for 1-error correcting codes

standard arrays + standard array decoding

syndrome decoding

Thm two vectors are in the same coset iff they have
the same syndrome.

step by step

ch 4 first order Reed-Muller codes $G = \left[\begin{array}{c|c} 1 & \\ \hline H_r & 0 \end{array}\right]$

Hadamard matrices, Hadamard transform

Proper ordering of binary r-tuples

decoding Reed Muller codes

self dual codes
Binary extended Golay code and its decoding algorithm.

ch 5 **cyclic codes**

cyclic subspaces
cyclic codes
polynomial rings + ideals Zech's log tables
generators of ideals
The correspondence between cyclic subspaces of $\mathbb{F}_q^n$ and
$g(x) \in \mathbb{F}_q[x]$ with $g(x) \mid x^n - 1$
deg of g and the dim of the code
encoding cyclic codes (in poly language not necessarily in bit language)
syndromes + remainders
and syndromes of cyclic shifts
cyclic runs
error trapping algorithm
error trapping for burst errors
burst errors can be corrected if they're in distinct cosets
cyclotomic cosets
factoring $x^n - 1$

ch 6

BCH codes

Thm If $g(x)$ is a gen poly of a cyclic code C and has roots $\alpha_1 \dots \alpha_{n-k}$ in some field where it splits then $t(x) \in C$ iff $t(\alpha_i) = 0 \quad \forall i$

BCH codes
- designated distance
- primitive BCH code
- narrow sense BCH codes

BCH bound proof (ie $d(C) \geq \delta$)

independent set + $wt(h(x)) \geq |A| \quad \forall A$ inde wrt the roots of h

BCH decoding

Bar codes and other fun stuff

MATH 343 applied combin

generating functions
counting
building random objects — Boltzmann generators

MATH 821

(strong undergrads can be signed in)

generating functions
combinatorial Hopf algebras
partitions